

Underwater Archaeology

DENISE C. LAKEY, EDITOR

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FOREWORD

DENISE C. LAKEY, EDITOR

At this year's meeting, the Society for Historical Archaeology celebrated the 30th anniversary of its founding. Only three years after its birth, the SHA conference saw its first underwater archaeology session. Those sessions continued to expand until the meetings became officially known as the SHA Conference on Historical and Underwater Archaeology in 1987. For some time now, the underwater sessions have occupied approximately one-third of the conference. During these three decades of growth and development, underwater archaeology has clearly been an integral part of the Society. For those interested in the history of underwater archaeology and the SHA, George Fischer's chronicle, "The Conference on Underwater Archaeology and the Advisory Council on Underwater Archaeology: A Brief History," is published in the *Proceedings from the Society for Historical Archaeology Conference* 1993:2-6, edited by Sheli O. Smith, Kansas City, Missouri.

The 1997 conference's underwater program was one of the largest ever (from 110 abstracts submitted, 93 papers were presented) and covered a wide range of interests, periods, and geographic areas—medieval Chinese anchors; Byzantine wrecks; Greco-Roman ports; colonial Portuguese Africa and India; development of cultural resource management in the Caribbean, Mexico, Bermuda, and Ireland; steamboats in Montana and Idaho as well as the South; medieval European ships and bridges; American Naval archaeology ranging from Revolutionary War shipwrecks through World War II aircraft lost at sea; technical and theoretical advances; pre-Columbian sites; issues and models of cultural resource management in the U.S.; ships and ports of European expansion; neolithic seafaring; vernacular boats; developments in shipbuilding technology; and westward American expansion.

Perhaps this year's quantity of papers was directly related to the difficulties of the 1996 con-

ference: three snowstorms and the federal government shutdown prevented many people from presenting their research. As a result, several papers originally scheduled for 1996 were presented in 1997. Of the 93 papers presented, 51 (55%) were devoted to foreign sites or issues. The count includes the CSS *Alabama* lost off Cherbourg, France, and the *Geneva Kathleen*, a Texas lumber schooner lost off Grand Cayman.

As it has for the past several years, the Society is publishing some of this year's best writings on underwater archaeology. This publication, renamed *Underwater Archaeology* in 1996 from the much longer and more cumbersome *Underwater Archaeology Proceedings from the Society for Historical Archaeology Conference*, provides an annual forum for the latest in technology and methodology, underwater cultural resource management, and current research from around the world ranging from prehistory to the beginning of the present century. The Society's commitment to publish *Underwater Archaeology* annually has been a big step in the growth of our profession. It provides a quality forum for the exchange of ideas and information with our colleagues and the public. To present the selected contributions best, this year's volume departs from the traditional organization by session or symposium.

The wider the base of support for *Underwater Archaeology*—both in manuscripts submitted and in organizations underwriting the publication costs—the more important the publication becomes to the profession. This year, 59 of the 93 (63%) underwater program participants submitted manuscripts for consideration. Having many papers submitted is both good and bad. The good side is that with increased competition, those papers published are more likely to make a substantive contribution to the field; be properly laid-out, referenced, and illustrated; and be clear, concise and enjoyable to read. The bad side is that many papers that are substantive, properly formatted, and enjoyable to read are not being published here simply because there is insufficient room in the volume. I hope many worth-

while contributions that did not find a place in the 1997 volume of *Underwater Archaeology* will be published soon in other venues.

Rather than discuss the merits and highlights of the items appearing between these covers, I prefer to let them speak for themselves. That is their purpose. However, I was encouraged by the papers from the symposium entitled "Problems and Progress in Underwater Cultural Resource Management in the Caribbean, Bermuda, and Mexico." Not all of the papers from the symposium could be published here, but taken individually and as a whole, they showed that progress really has been made—though of course, many problems persist.

I thank the other members of the conference committee for all their hard work: Dr. David Carlson, Dr. Shawn Carlson, Dr. Frederick Hocker, and Toni Carrell. For her achievement in putting the abstracts and the schedule into booklet form and for organizing and overseeing the volunteers, whom I also thank for their labors, I express my gratitude to Becky Jobling. I also extend my sincerest appreciation to Mary Caruso, whose help with local arrangements and the photo contest became indispensable when Toni was snagged by the *Belle* shipwreck in Matagorda Bay. For easing my job as underwater program chair, I am especially grateful to those who hosted luncheon round tables or served as session or symposia chairs. Thanks also are extended to those who presented papers at Corpus Christi for making the conference worth all our efforts.

I am indebted to Michael Rodeffer for his help with the business issues and mailings involved with this publication and to Dr. Ronald Michael, the SHA editor, for all his patience with me. Each year Ronn has to help a new *Underwater Archaeology* editor navigate the mine-strewn harbor of editing these papers. I also want to acknowledge the work of Robyn Woodward and Toni Carrell in compiling the associate editor's guide for *Underwater Archaeology* in 1994. How did the editors before 1994 manage the task without it? Finally, sincere thanks go to every author who submitted a manuscript for consideration.

This publication is made possible by the generous contributors listed on the previous page. Without their help, there would be no *Underwater Archaeology*. I also wish to acknowledge specifically those contributors from last year who, through oversight or miscommunication, were not listed in the 1996 volume but gave again this year anyway—Martin Klein and R. Christopher Goodwin and Associates. Their generosity of spirit is appreciated even more than their generosity of pocketbook. I also want to express my appreciation to Dr. Donald Keith and Ships of Discovery for giving me the time and support to organize the underwater program and edit this volume.

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The *Hollandia* and the *Amsterdam*: Ships and the Economic Network of the VOC in Amsterdam around 1750

Introduction

Traditionally, our knowledge of the Dutch East India Company (VOC) and its ships has been based on written and iconographical sources. Thanks to underwater archaeology, now a new source of information has become available, namely the material remains of sunken VOC ships. VOC wrecks are a specific category of research subject. Due to their particular historical background, being part of a bureaucratic trading company, archival references are available for archaeological research. The integrative historical and archaeological study of VOC ships provides a theoretical and methodological framework to elaborate on one of the basic challenges in underwater archaeology today, namely how and to what extent sunken ships can inform us of the larger technological, socioeconomical, and cultural systems of the society from which they originate.

Two mid-18th-century VOC ships, the *Hollandia* and the *Amsterdam*, have provided a case study on the material facilities and the industrial organization with regard to the company's ship production in the city of Amsterdam in the 1740s. After their underwater archaeological excavations which took place in the 1970s and 1980s, research focused first on the functional classification of the archaeological finds (Gawronski et al. 1992). Next, attention shifted to the manufacturing and equipping processes of these two vessels (Gawronski 1996). Both ships will be discussed here as an example of how archaeology, or more precisely, material culture studies of sunken VOC ships, can provide new insights in the functioning of the VOC and its place in Dutch society. In particular, the relations between these ships and the city of

Amsterdam as the center of the economic network of VOC shipbuilding and shipping activities will be highlighted.

Intercontinental Shipping of the VOC

The VOC was a private trading organization with an intercontinental scope. During two centuries (1602-1795), the company developed and maintained a shipping network between Europe and Asia and shipping links within the intra-Asiatic trade. The VOC used its own ships and was shipbuilder, shipowner, and shipper all in one. Due to its geographical range, the company was structured in two main entities. The largest structure was the overseas empire, comprising parts of Africa, the Middle East, and the Asian continent. Being authorized by the Dutch States-General to make treaties with foreign sovereigns and to defend the State's interests, the overseas company was also a government and military force. It had a network of some 300 settlements with the city of Batavia (Jakarta) as the governmental center. In the 18th century, the number of personnel overseas amounted to 25,000, while 15,000 people worked on the ships sailing to and from Asia.

The second entity was the home country, where the VOC had establishments in six Dutch cities: Amsterdam, Hoorn, Enkhuizen, Rotterdam, Delft, and Middelburg. These six chambers were controlled by a central board of management which was based in Amsterdam. The Oostindisch Huis (East India House) in the city center was the main office with a number of different departments, such as the offices for the administration of goods and personnel, the hydrographic office, the medical department, and the archive. Above all, it was the decision-making center containing the office of the Heeren Zeventien (the seventeen chosen directors) which stood at the top of the pyramidal VOC organization.

However, topographically and functionally, the most important facility in Amsterdam was the shipyard and its buildings on Oostenburg, one of three artificial islands in the eastern part of the harbor (Figure 1). Here, in only five years, a large scale and fully developed complex for the

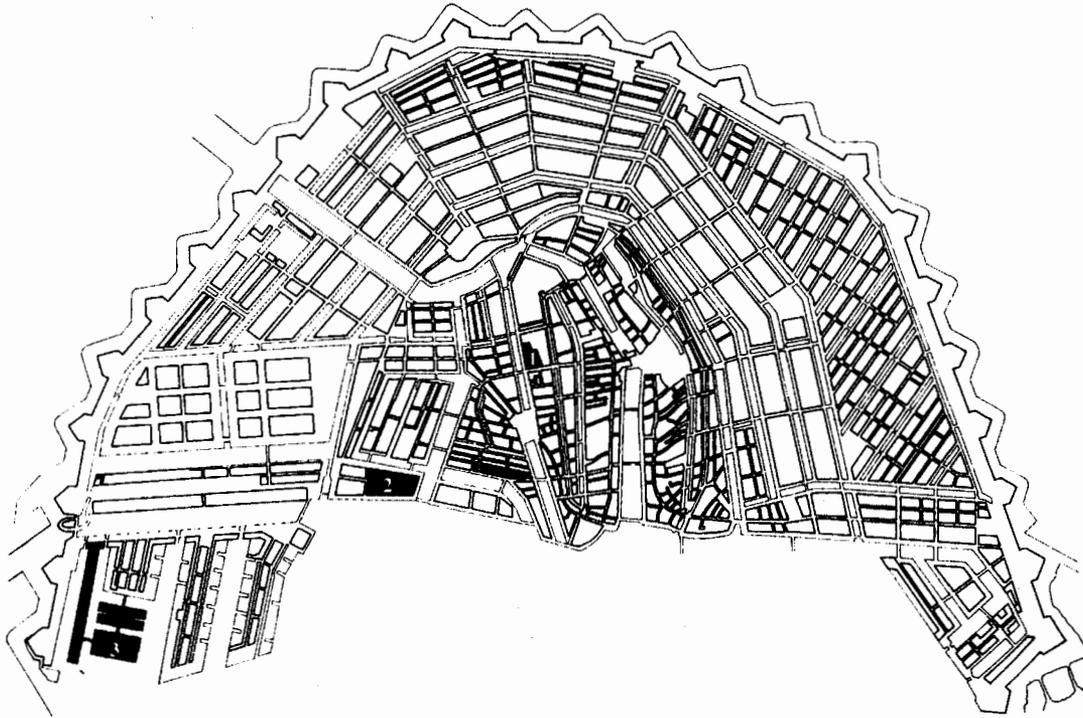


FIGURE 1. Plan of the city of Amsterdam in the 18th century with the VOC facilities: 1. East India House; 2. the old shipyard; 3. the shipyard on Oostenburg.

constructing, supplying, equipping, and receiving of fleets was built during the 1660s. The yard's main features were a large, multifunctional warehouse (Figure 2), which was 215 m long and 6 stories high; a 500-m-long rope walk; three slipways; and several utilitarian buildings and workshops. The yard had a high production rate of three to five ships per year, culminating in seven ships in 1746. Standardization of equipment and supplies made it possible to dispatch fleets of up to 15 ships per year from Amsterdam to Asia. During its two centuries of existence, the VOC built a probable total of 1,600 ships, half of which were produced in Amsterdam. These vessels created a bridge between Europe and Asia. The total number of shipping movements on the intercontinental route amounted to more than 8,000 voyages (4,789 outward bound and 3,401 inward bound), not taking into account the intensive traffic of VOC

ships in the intra-Asiatic trade (Bruijn et al. 1987).

VOC Wrecks

In 200 years time, approximately 250 ships (105 outward bound and 141 inward bound) were lost, i.e., 3 percent of all voyages had a fatal end. The archaeological record of VOC wrecks which have been discovered in the last 35 years presently consists of approximately 40 sites (Figure 3; Gawronski 1996). They cover the entire VOC period and date from 1606 (the *Nassau* and the *Middelburg*, Straits of Malacca) to 1795 (the *Zeelelie*, Scilly Isles). This number is increasing annually, particularly as a result of ongoing search and salvage activities in Asian waters. Unfortunately in many cases, the discovery leads to commercial exploitation rather than scientific research. The available material record

shows inconsistencies due to differences in field-work methodology and even the lack of systematic techniques. Nevertheless, despite their attraction to salvors, a fair number of sites have been investigated in a sound archaeological fashion. Another factor contributing to qualitative variation in the material record is the natural environment of the sites in combination with the shipwrecking process. Wrecks are located in diverse conditions on the European, African, Asian, and Australian coasts, varying from the cold Atlantic to the tropical Indian Ocean.

In terms of site formation processes, the *Hollandia* and the *Amsterdam* represent two extremes of a wide spectrum. The *Hollandia* is a basic example of a site with a high degree of mechanical disturbance. This vessel sank in 1743 at the Scilly Isles after hitting a rock and ripping its hull. The site consists partly of bare rocks and gulleys where a heavy swell and strong current occur. The wreck remains cover a large area. Ship's timbers are absent while organic and other delicate materials are poorly preserved and

artifacts are highly fragmented and randomly distributed. Excavation activities which started in 1970 extended over a period of ten years and resulted in an extensive collection of finds. These offer only a limited representation of the original contents of the ship as they mainly originated from a restricted area within the site where a particular section of the vessel was deposited.

The *Amsterdam*, on the other hand, can be considered as the best-preserved VOC wreck known to date. The ship was beached in 1749 near Hastings on the English south coast in a silted up riverbed. In just a few months, the entire hull sank under its own weight into 7 m of soft sand. The ship's structure survived above the lower gun deck, and its contents became shielded by layers of protective silts, reflecting a relatively high degree of spatial coherence. Consequently, the potential for information about the original material assemblage is high. Archaeological data became available through low-water surveys in the early 1970s and three underwater

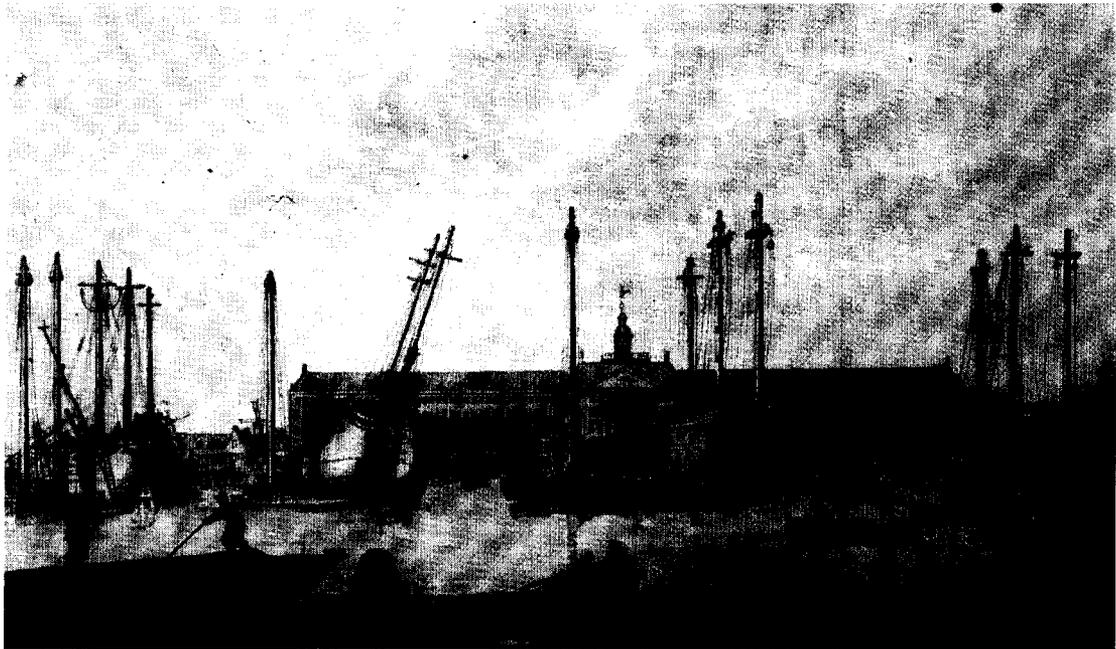


FIGURE 2. View of the shipyard on Oostenburg with the main warehouse in the background. (Drawing by H.P. Schouten, ca. 1870.)

archaeological excavations in 1984-1986. Notwithstanding its varied and detailed nature, the archaeological record should be considered a sample since the excavation was limited to the upper structure of the stern section and the larger part of the wreck is still awaiting further research.

Levels of Archaeological Interpretation

The *Hollandia* and the *Amsterdam* are two extremely diverse archaeological assemblages. Nevertheless, they are closely linked historically, as both VOC ships date from the 1740s. This historical background provides a common structure for the interpretation of their material record. Essentially, VOC ships can be characterized as the multifunctional tool of the company to create and maintain a worldwide network of trade and industry. They were part of an intricate economic and political system which led to technological and cultural exchange on a global scale. Therefore, VOC ships contain in a nutshell all the elements of the preindustrial era of 17th- and 18th-century Holland. They were complex assemblages composed of many thousands of artifacts and designed for many different purposes. These ships acted as military platforms with guns and soldiers; they carried cargo and provisions for the overseas settlements as part of an economic trade and supply system; they were floating villages accommodating a crew of more than 300 men with a ranked social structure and differentiated labor; they were the post office and the bank of the company, transporting archival documents and currency. In fact, they represent a microcosm of the VOC, expressed in a material and three-dimensional way.

From this point of view, the material remains of the *Hollandia* and the *Amsterdam* offer information on three interrelated domains. First of all, archaeology provides data on manifold aspects of the individual ships, for example, regarding ship's structure, armament, and composition of cargo and equipment. Furthermore, remains of personal belongings and ecofacts provide data on the individuals and the ecosystem on board, re-

vealing a level of material reality which is generally lacking in the archival record.

Secondly, both ships originated from an identical phase in the history of the VOC and were products of the company in Amsterdam. They were newly designed and freshly built, in 1742 and 1748 respectively, in the same yard. They both perished on their maiden voyage shortly after departure. Therefore, their material remains reflect the practice and procedures of the yard and its labor force in Amsterdam.

On a third level of interpretation, we find that the VOC and its shipyard were not closed entities but part of a larger system, in this case the city of Amsterdam. The VOC production center functioned on the basis of an urban supply network and labor system. Although the company was mainly self-sufficient, it needed to rely on hundreds of artisan's workshops and merchants in the city for material and goods needed to manufacture and equip these ships. Their material remains are not only related to the activities of the VOC but also provide us with information regarding urban trade and industry sectors.

Historical-Archaeological Integration

These three criteria for interpretation of the archaeological record gave an impetus to further historical research into the practical organization of the shipping activities of the VOC. In historiography, the economic development of the company has been well documented, but too little attention has been paid to practical aspects, such as structure of the work force, logistical means, and technological facilities. Archaeology highlighted the need for a historical framework illustrating the material process of the *equipage*-constructing and equipping ships-of the VOC. The 1740s brought a new stage of modernization. As ship production intensified, the company reached its peak in the number of settlements overseas as well as in the number of its personnel in the Republic and in Asia. Commercially the situation was less favorable: profits started to decrease and debts grew. There seems to be a discrepancy between the industrial organization



FIGURE 3. Sites of VOC ships (Gawronski 1996): 1. *Naussau*, Middelburg (1606) 2. *Mauritius* (1609) 3. *Witte Leeuw* (1613) 4. *Banda* (1615) 5. *Geunieerde Provincien* (1615) 6. *Campen* (1627) 7. *Batavia* (1629) 8. *Rob* (1640) 9. *Lastdrager* (1663) 10. *Vergulde Draeck* (1656) 11. *Hercules* (1661) 12. *Kennemerland* (1664) 13. *Princesse Maria* (1686) 14. *Dageraad* (1694) 15. *Oosterland*, Waddinxveen (1697) 16. *Huis te Kraaienstein* (1698) 17. *Meresteyn* (1702) 18. *Liefde* (1711) 19. *Zuytdorp* (1713) 20. *Bennebroek* (1713) 21. *Slot ter Hooghe* (1724) 22. *Akerendam* (1725) 23. *Zeewyk* (1727) 24. *Risdam* (1727) 25. *Adelaar* (1728) 26. *Vliegent Hart* (1735) 27. *Boot* (1738) 28. *Vis* (1740) 29. *Hollandia* (1743) 30. *Reijgersdaal* (1747) 31. *Amsterdam* (1749) 32. *Geldermalsen* (1752) 33. *Bredenhof* (1753) 34. *Buitenzorg* (1760) 35. *Leimuiden* (1770) 36. *Nieuw Rhoon* (1776) 37. *Middelburg* (1781) 38. *Zeelelie* (1795).

and the (lack of) commercial success. By confronting archaeological data on the *Hollandia* and the *Amsterdam* as well as historic information from a number of documents from the Amsterdam municipal archive and the VOC company archive, details became available on the activities in the yard and on the policy of the company during the very period these ships were constructed and prepared for their journey.

Such a dual approach based on material culture and written sources is a basic feature of VOC ships research. In historical archaeology, it seldom occurs that archaeological and historical sources are so closely related as in the case of the VOC: both ships and documents have been produced within the same context. This common origin offers ideal assumptions to interpret remains of material reality in close concordance with reflections about the past on paper. On a broader level this issue fits in the post-processual archaeological discussion about meaning of material culture which started in the 1980s (Hodder 1986; Shanks and Tilley 1987; Moreland 1991). Here the basic point is the definition of the symbolic value of material remains as carriers of sociocultural data. With respect to the methodology of historical archaeology, this discussion underlines the necessity of a broader documentation of material culture, dispelling as much as possible the restrictions of archaeological sources by means of historical information. The documents from the VOC archive provide new criteria for archaeological interpretation, while archaeological "real life" data present new approaches for historical research. Due to the mutual discrepancy of both types of sources, in which each discipline behaves independently from the other and has its own methods, common questions are necessary to provide neutral conditions for successful integration.

For example, archival information derived from instructions made it possible to fill in details of the material assemblage of VOC ships, such as the kinds and quantities of tools on board or the composition of the apothecary's chest. These particular historical sources should be used critically in an archaeological context.

Documents like instructions only partly reflect reality as they were issued to counteract processes which differ in practice. A crucial archival source for these material culture studies is the bookkeeping journals. This type of document contains records of the actual purchases and provides the link between the production of ships and the urban supply system. Their accounts are ordered monthly in 41 alphabetical categories of materials and logistical costs which contain the names of suppliers and manufacturers, the number and nature of their products, and all possible other types of data such as origin or quality of goods. Systematic analysis of these expenditures for the 3-year period in which both ships were constructed and equipped (1742–1743, 1747–1749) resulted in varied information on the scale and nature of personnel and the supply system of goods and services of the VOC. These data are the basis for further analysis of technological, socioeconomical, and industrial aspects of VOC shipbuilding to support archaeological interpretation.

The Economic Network of the VOC in Amsterdam

The historical research triggered by these two shipwrecks resulted in a new image of the organization of the yard. A striking outcome was that during the 1740s the company was more developed in terms of labor differentiation, allocation of tasks, and organizational structure than was generally assumed. Its work force was divided into approximately 170 different functions. The personnel consisted of about 1,300 employees, of which some 170 belonged to the administrative, technical, or executive staff. The remaining 1,100 were workmen on the shipyard, storehouses, supply ships, or several services such as the transport sector and the slaughterhouse. This structure was the result of a process which started in the last decades of the 17th century and continued through the first half of the 18th century. The 1740s should be regarded as a crucial period in which the company organization reached its peak. The personnel network

illustrates a complex business structure which consisted of a pyramidal system of centralized management with a highly developed horizontal segmentation of autonomously functioning subdivisions. At the base of the pyramid was a broadly organized system of independent departments, each with its own directors, foremen, and workmen, specialized in a certain aspect of the total production process. Each function or job had a basic remuneration based on an annual salary or daily wages, but simultaneously, a complicated system of pay increase was applied on the basis of seniority or personal qualifications. This flexible payment system was the core of the VOC personnel policy in which a review based remuneration served to stimulate and control performance. The payroll also shows annual costs for daily wages for workmen mounting to 1,000,000 guilders, twice as much as was assumed on the basis of available data thus far; the staff wages show an average annual total of 140,000 guilders.

The bookkeeping accounts also provided an insight into the scale and diversity of the company's supply system. The need for building materials, equipment, raw materials, and provisions for the ships, the onshore divisions, and the overseas settlements resulted in several hundred purchases per month, varying from guns to cheese, from telescopes to sheets of copper, and from timber to chemicals. Supplies were generally in large quantities: deliveries of 28,500 pine planks, 1,000,000 pounds of bacon, 2,700 seaman's chests, or 8,200 bars of iron were not unusual. Simultaneously, more moderate quantities were purchased, depending on the nature of the goods, such as four ship's fire engines, four microscopes, or ten pounds of Spanish fly.

Quantification of the supply system showed that on a yearly basis more than 400 small stores, workshops, or large merchant houses were involved (402 in 1742–1743, 404 in 1747–1748, and 463 in 1748–1749). Over the 3-year period (1742–1743, 1747–1749), a total of 680 different suppliers was active, of which 72 percent were based in Amsterdam. Although the choice of suppliers showed a high degree of continuity,

general changes occurred in the mid-1740s: not only their number grew, but new suppliers also appeared, sometimes in addition to the existing ones and sometimes as replacements. These measures seem to be related to the company's attempts to maintain a grip on the supply market by appointing agents or permanent contacts. The professional backgrounds of these suppliers show a strikingly high degree of specialization. The VOC ensured the cooperation of specialists in certain sectors, for example the municipal assayer for the supply of scales. Generally, the number of suppliers depended on the nature of their products. In regard to artisans' products, such as tools, the same specialized workshop was repeatedly hired, while in the commercial sectors often different traders were engaged. The general tendency, however, was directed to centralization by appointing a main supplier for a certain type of product, particularly when these goods were purchased regularly in great quantities.

The analysis of these specific infrastructural, technical, and material facilities shed more light upon the scale and structure of the VOC organization in Amsterdam. This data is of relevant use for the current discussion on the modernity of the VOC as an industrial and commercial company in the preindustrial period. This study also demonstrates that the confrontation of material culture and written sources continuously provides new approaches and criteria to the question of how the VOC functioned on a practical level in daily life. In this respect, a useful methodological basis is given for future historical-archaeological research into VOC wrecks and other ships from the postmedieval period.

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Mapping Shipwreck Sites by Digital Stereovideogrammetry

Introduction

Since the mid-1980s, commercial photogrammetry has been transformed from an analog to a largely digital process. The reason is simple. Since then, more than 100 software packages have been marketed around the world, all with the same function—to manipulate large data sets that share a common spatial reference system. The generic name for these packages is geographic information systems (GIS). A more precise term is *spatial information systems* (SIS), by means of which traditional geographic data may be manipulated as well as other spatial data types and sets, such as those associated with an archaeological excavation.

Some SIS packages, in addition to having a wide range of spatial manipulation routines characteristic of traditional map analysis (e.g., scaling, resizing, georeferencing, editing, mosaicking), also contain subroutines to perform most of the analyses that were done by traditional analog photogrammetry. These subroutines have evolved from image processing programs originally written to analyze satellite imagery. Their importance to SIS packages is clear: image capture is one of the fundamental methods to get spatial data into the package for subsequent analysis. The term for this digital photogrammetric processing is *soft photogrammetry*.

Prior to the mid-1980s, photogrammetric analysis was based on algorithms and equipment developed in the 1930s. Traditional stereoscopic photogrammetry requires more than a little mathematical knowledge, as well as complex optical-mechanical equipment, both for the capture of images and for their subsequent processing by analog stereophotogrammetric mapping techniques. This has all been changed by the new SIS packages and their rapidly evolving successors.

Background

Photogrammetry is defined as “the science or art of obtaining reliable measurements by means of photography” (Pollio 1968). Not surprisingly, it was the U.S. Navy that undertook some of the earliest research applying stereophotogrammetry to large scale mapping of the ocean floor (Shipek 1967; Pollio 1968). Apparently the Navy’s interest was spurred by the very early use of optically precise underwater cameras by Dimitri Rebikoff (1961), an inventor and pioneer in the use of photography and photogrammetry, to record underwater archaeological sites. Rebikoff (1984) later published the first nonclassified paper outlining the potential application of video cameras and videogrammetry to mapping underwater sites, another indication of his perspicacity and foresight.

A very relevant case study in applying analog underwater photography and stereo-photogrammetry to mapping a shipwreck site remains Rosencrantz (1975). His paper contains detailed information on the practical aspects of generating photomosaics from a single 35-mm camera film format, used with a military surplus Kelsh plotter, to document several Turkish shipwrecks excavated by George Bass in the 1960s and early 1970s.

The most recent comprehensive review of underwater photogrammetry is Newton et al. (1989), which also contains a complete bibliography. It is presented from an engineering viewpoint and discusses the optics of underwater photographic systems and specific hardware configurations. Their paper just predates the general adoption of soft photogrammetric packages, which are mentioned briefly in the section on analytical methods.

Recent experimental applications of underwater photography and videography to record shipwrecks can be found in Green (1990:99-122; in addition to many earlier papers); Farb (1992) on video image digitization, not videogrammetry; Garrison (1992) on convergent rather than stereoscopic photogrammetry; and MacNeill (1994) on use of a SIS package.

In both the traditional analog and the new digital technologies, photogrammetric techniques are used to correct systematic and perspective distortions in an image—whether an air photo, a satellite image, or underwater video frame—to give it maplike internal geometry. In stereophotogrammetry, the spatial parallax in sequential pairs of stereo images is used to derive three-dimensional surface information. For this project, that information is a microtopographic contour map of part of an underwater archaeological site.

Applying Digital Stereovideogrammetry to Shipwreck Sites

Since 1993, I have been developing a technique that uses COTS (Commercial Off-The-Shelf) video hardware and SIS software to create microtopographic maps of underwater sites. The concept has been proven, and the basic research is completed. Only more field development is needed to distribute a standard processing script that may be used on underwater (and terrestrial) sites to produce computer and hardcopy plans with XYZ dimensional accuracies of 2 cm or better.

This approach is based on high-resolution video records of underwater archaeological sites referenced to a user defined XY coordinate system, followed by the transformation of individual video frames into raster files that are manipulated by the SIS. Thus it may be most pedantically termed *underwater digital stereovideogrammetry* (UDS?). It differs from aerial or satellite stereophotogrammetry in terms of its image capture technique and its scale, which is some four to six orders of magnitude smaller than aerial or space based systems.

However, the technique does use a traditional photogrammetric data-gathering approach—analysis of pairs of images of objects (e.g., hull remains and artifacts) visible on the bottom. The image pairs have a fixed base distance of 0.5 m between their center points. But rather than recording the area of interest using a large-format metric camera or a space based scanning system, data collection is accomplished by a Hi8 video



FIGURE 1. An 8-bit unsigned integer gray scale raster of the San Pedro anchor, 512 x 482 pixels.

camera in an aluminum housing equipped with a wide-angle dome port.

In essence, the camera platform is a SCUBA diver rather than an airplane or a satellite. As the diver swims at a fixed height of 1.5 m above the XY coordinate grid, the video camera records whatever is visible on the bottom at the standard speed of 30 frames per second. Assuming a forward swimming speed of about half a knot, or 0.25 m per second, 60 video frames will be recorded on tape every 2 seconds as the diver swims along a north-south grid line from one control point to the next 0.5 m down the line (see below).

The SIS package used for this project—TNTmips versions 4.5–5.5, written and distributed by MicroImages, Inc. (Lincoln, Nebraska)—has the capability of grabbing video signal frames (primary and secondary fields) and creating rasters from them; registering the rasters to an arbitrary, user defined coordinate system; rectifying the registered rasters by applying various models of distortion; sampling raster image pairs with a prospective projection subroutine; and from these left-right pairs, generating elevation models. These models may be either traditional Digital Elevation Models (DEMs) or the more efficient data structures called Triangulated Ir

regular Networks (TINs). No other software is required, and in fact the routines used in this project only comprise about 5 percent of all the routines available in the package.

Summary of Processing Steps

Fieldwork

Ground control is established by a portable video grid formed by two plastic I-beams 6 m long, which establish the north and south sides of a rectangle. Strung between the I-beams at 0.5-m intervals are 13 leader lines. Along these 13 lines are glued 1-cm-diameter white plastic balls—the control points—also at 0.5-m intervals. All leader lines are 8 m long, producing a collapsible grid that, when unrolled and deployed over a portion of an underwater site, is 6 x 8 m. The video grid is designed to be neutrally buoyant and can be secured at a fixed height above

or below the site datum, then referenced to the datum for elevation reductions.

To cover the hundreds of square meters of a large underwater site, the video grid must be systematically redeployed along temporary baselines set up over the site. After each grid position is videotaped, the grid is repositioned in a process that takes 30–60 minutes, depending on bottom conditions.

Post-Fieldwork Computer Processing of Video Imagery

Hi8 tape coverage of the area recorded below each video grid position is played back through a monitor and passed through a framegrabber card on a desktop computer. A video frame is captured each time the plum bob hanging from the front of the camera housing passes one of the control points spaced at 0.5-m intervals along the leader lines.



FIGURE 2. Same image as Figure 1, georeferenced and warped to real world coordinates.

Each Hi8 video image is captured (framegrabbed) at 512 x 482 pixels, which represents the National Television Standards Committee (NTSC) 4:3 aspect ratio for U.S. TV signals. A single 24-bit color composite raster is captured at each control point, representing a single frame of NTSC video.

After an image has been framegrabbed, three corrections and transformations must be applied to it. Due to the limitations of print publication, the illustrations only show the test image used in this demonstration—the mid-18th-century wooden stock anchor placed on the *San Pedro* Underwater Archaeological Park in the Middle Florida Keys—after the first of the transformations already has been applied.

Figure 1 shows an 8-bit unsigned integer gray scale raster of the *San Pedro* anchor that was extracted from the framegrabbed 24-bit color composite image by transforming the raster's red-green-blue composite color model into a hue-intensity-saturation color model and discarding both the 8-bit hue and the 8-bit saturation image components because they contain very little useful information. The remaining intensity raster is both relatively small in size and full of information on light intensity changes over the bottom, which is our basis for seeing anything.

The following objects should be visible in Figure 1. Bolted to the anchor shank by two transverse brackets is a zinc sacrificial anode. A small, isolated coral head rests on the flat rock bottom on the other side of the anchor shank. The distance between the anchor's fluke tips is about 1.8 m, to give some idea of scale. To give some idea of image resolution, on a 1024 x 768 monitor display, the four bracket bolt heads (each about 1 cm in diameter) are clearly visible on the sacrificial anode brackets clamped to the shank. The capture resolution of this image, 512 x 482 pixels, is just under a quarter-million pixels. While it is not nearly as fine as in a 35-mm film image, it is, remarkably, more than sufficient for digital stereovideogrammetry.

In the center of Figure 1, superimposed on the anchor shank, is a small dark circle that represents the camera plum bob, hanging 1.5 m below the camera housing. The plum bob is here

suspended directly adjacent to the video grid control point (the 1-cm-diameter white plastic ball) located at Y-coordinate (northing) equals 7 m and X-coordinate (easting) equals 1 m. This figure gives some idea of areal coverage, roughly 2 x 3 m, of a portion of the 48-m² video grid with the video camera located 1.5 m above it. Also visible, at the top edge of the raster, is the western half of the northern side of the video grid, a 3-m-long portion of the plastic I-beam.

Note the squeezed appearance of the framegrabbed image in Figure 1. This appearance illustrates the NTSC broadcast video aspect ratio of 4:3 when displayed on a computer screen. In the second transformation step, the image aspect ratio is corrected to the standard square pixel size (aspect 1:1) used on computer display monitors. This is a straightforward procedure within the SIS package, involving resampling and interpolating all columns and



FIGURE 3. A 32-bit, single-precision elevation raster surface derived from TIN of *San Pedro* anchor.

rows in the raster image from 512 x 482 pixels to 640 x 480 pixels (results not illustrated here).

Georeferencing and Warping Images

Even after a transformation to square pixels, major distortions (not shown here) are quite apparent in the *San Pedro* anchor image. The plastic I-beam forming the north side of the video grid remains bowed, illustrating the "pillow" distortion introduced by the underwater housing's wide-angle dome port, rather than the effect of a 4:3 aspect ratio. All such internal optical system distortions must be removed from captured raster images before they can be transformed into stereo pairs for generating an elevation raster.

Prior to digital photogrammetry (or videogrammetry), it was essentially impossible to mathematically or mechanically correct analog imagery for the very great amount of internal camera distortion found in any non-metric camera, particularly a COTS video camera in an underwater housing. Therefore, it is this corrective step that makes the whole digital processing technique possible.

In order to warp the raster image back into real world coordinates, a subroutine in the SIS package may be used to add control points at known locations in a coordinate system. This is the purpose of temporarily establishing a video grid over an area of the wreck site prior to videotaping. To prepare a large scale plan of an underwater site, we register each raster to a user defined Cartesian coordinate system based on the overall site grid. As noted above, in this field test we used a 0.5-x-0.5-m grid with a 0,0 false origin that can easily be related to the site datum. The SIS program's georeferencing module was set to use the UTM coordinate system (Z16), the GRS1980 ellipsoid, and a Transverse Mercator Projection.

The 1-cm-diameter plastic balls attached to the video grid provide the necessary information as they are all in a horizontal datum plane held by the grid at a known elevation relative to the site datum. A minimum of 20 control points must be

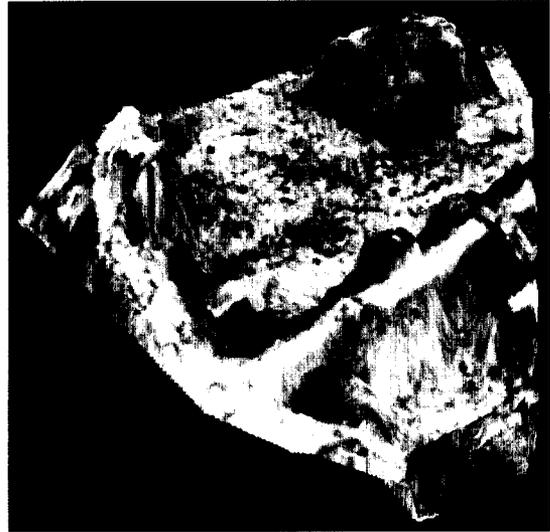


FIGURE 4. Three-dimensional view of *San Pedro* anchor, looking west at a viewing angle of 30°.

identified on each image for subsequent processing.

In addition to the video grid control points, which are all at the same relative elevation (0 m), a small number of real elevation values must be recorded for use in the subsequent elevation extraction routine. These values are recorded by divers by measuring above or below the plane of the video grid to easily identifiable points on the wreck (here the tips of the anchor flukes, or the bolts on the coupling bracket). About four such points are needed for each raster stereo pair.

Each raster is transformed, pixel by pixel, by an SIS subroutine in order to remove its internal distortion before exporting to the software subroutines that actually produce a stereo pair. In essence, the resampling subroutine takes a warped image as input and restores its original geometric properties, as represented by the control points at known XY coordinates. Using analog photogrammetry, only a tiny fraction of points visible on a photographic print could be so transformed by hand in a reasonable amount of time.

Figure 2 shows the result of the warping procedure performed on the same image seen in Figure 1. The I-beam has now been warped back to its real world orthogonal geometry. In fact, each pixel in the raster has been relocated so as to conform to the 0.5-x-0.5-m grid system laid over this portion of the site prior to videotaping. On the computer screen, one can apply cursor based tools to this corrected image and immediately measure lengths, areas, and angles of visible objects accurately to the nearest millimeter.

By combining this fully corrected raster with a similarly corrected raster captured either 0.5 m north or 0.5 m south of this image, one obtains the input for the next step of the stereovideogrammetric mapping procedure.

Prospective Projection of Rectified Images

After a pair of adjacent rasters has been image enhanced, georeferenced, and warped to remove the two-dimensional internal camera distortions, the pair is submitted to a prospective projection subroutine of the SIS package. The subroutine again resamples them, but now into a left-right stereo pair with an identical Y-axis orientation. In other words, the stereo pair now shares a common, epipolar geometry along their Y-axes.

As a result, all remaining differences in the position of objects along the X-axis reflect their stereo parallax, a visual manifestation of their height above, or depth below, the video grid datum plane. It is not possible to display on paper, but if one looks through a standard stereoscope at a raster stereo pair displayed on the computer monitor, a very convincing three-dimensional view of the *San Pedro* anchor appears.

Generating Elevation Models

In the final step of the stereovideogrammetric process, the SIS package uses the parallax information in the resampled left-right stereo pair to create an elevation raster object. Over the past decade most such objects have been Digital El-

evation Models (DEMs), a data structure created and defined by the U.S. Geological Survey.

A more recent (and efficient) coordinate data structure for XYZ surface information is the Triangulated Irregular Network. TINs represent a continuous surface by a numerically large set of very small triangles whose size and distribution are computed from irregularly spaced three-dimensional points, the positions of which are optimized by the software. Generating a TIN may be thought of as analogous to draping a fishing net with fine triangular mesh over the bottom and all objects rising above it. While the net is composed of many small, two-dimensional triangles, given a sufficient density they conformally approach the three-dimensional surface in the same way that a straight line segment approaches the limit of a curve in the calculus.

To represent the bottom microtopography with sufficient detail for archaeological purposes (i.e., 1–2 cm), the SIS package subroutine must be adjusted to generate a very large number of triangles covering the raster image. An irregular network of nearly 30,000 triangles was required to approach this resolution within a 2-x-3-m area covering the lower shank and both flukes of the *San Pedro* anchor.

Figure 3 shows not the calculated TIN (which is difficult to display) but a raster surface generated from it. There is a 1:1 relationship between triangle node locations and raster pixel values, expressed as single precision elevation values. The elevation raster of Figure 3 may appear to be an 8-bit gray scale image, but it is actually a 32-bit floating point data object, with an elevation value for each pixel automatically calculated to six decimal places (here rounded to two), representing sub-centimeter changes in elevation over the scene.

Figure 3 might be termed an *elevation image*. It is in fact identical to a DEM in its information content. It clearly displays the *San Pedro's* lower anchor shank, one of its flukes, and the small coral head. Edge effects caused by the lack of data in adjacent model areas appear as major spurious elevation distortions. Such noise would not be present within a complete 48-m²

data set but would appear only around its edges. On screen within the SIS package, it is possible to place the mouse cursor on any pixel in the elevation image of Figure 3 and read off its XYZ coordinate values in centimeters.

Several processing paths may be followed after generation of the TIN, of which the raster surface in Figure 3 is only a single example. For instance, one can generate a standard vector contour map of the bottom with a 2-cm contour interval and overlay it on the raster surface of Figure 3 to allow direct determination of the XYZ coordinates of any pixel on the bottom.

Alternatively, for lecture or demonstration purposes, a three-dimensional wire frame rendition of the surface can be derived from the TIN by the SIS package and then overlain (draped) with a high-gain filtered version of the original left raster image, produced to maximize contrast.

The results of the above two operations are illustrated in Figure 4. This is a three-dimensional view looking west (relative to the video grid) over the anchor shank and flukes, and the coral head, at an apparent elevation of 30° above horizontal. Using the SIS package, a series of such draped images might be created at 1° intervals, captured, and played back as a "fly-around," false-motion video, giving a very realistic (and accurate) perception of swimming around the *San Pedro* anchor or any part of the site desired.

Summary

Commercial off-the-shelf hardware and software have been used to generate elevation models of parts of a wreck site in the Florida keys. The final product will be a 32-bit TIN model of the wreck that is the base image for generating many other types of raster, vector, and CAD objects representing the same area. The technique presented here does not require a metric camera, nor custom software, nor a workstation. In 1993, all hardware and software used in this project was purchased for under \$10,000. No modifications have been made to either the hardware or the software in order to generate

stereovideo elevation models from the captured video imagery.

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The Archaeology of the Event — The Annales School and Maritime Archaeology

Introduction

One fundamental change in social and cultural theory in recent decades has been the number and variety of theoretical perspectives that have come to the fore. In archaeology since the 1960s, theoretical approaches have taken the form of everything from the “New” archaeology to post-processual archaeology as well as been informed by perspectives such as Marxism, feminism, and structuralism among many others. Nevertheless, among some archaeologists, there is still a strong and persistent atheoretical strain which supports and promotes the idea that archaeology simply collects scientific facts. This paradigm ignores those approaches that suggest that all data are theory laden or that data are affected by the paradigmatic and theoretical framework used to approach it. In fact, that theory determines which questions are considered important and why, and to some extent it determines the methodology and approach used to collect, record, and analyze the data. Furthermore, some archaeologists see the variety of theoretical approaches as a problem and seek to find a new, invariably single, and usually “scientific” theory that will provide all the answers. Unfortunately, just as the world of the past fails to conform to simple and singular notions about it, so the modern world of archaeological theory needs to be accepted as diverse, complex, and ambiguous. As Randall McGuire (1992:7) has concluded, “a diversity of theory in archaeology is desirable and essential, rather than a problem.”

Archaeology has traditionally lagged some distance behind the cutting edge of cultural and social theory, and one could say that maritime archaeology has been some considerable distance behind archaeology generally in this respect. Recently, some archaeologists, and even some maritime archaeologists, have begun a search for

a more holistic approach to archaeology informed by the social and cultural theory of the past thirty years.

The Annales School

There have been occasional complaints by archaeologists about sudden discoveries of new theoretical approaches that usually occur some years, or even decades, after their appearance in other disciplines such as history, philosophy, sociology, or semiotics (Murray and Allen 1986:85-86; Bintliff 1991:1-2). One example of this phenomenon is the relatively recent discovery by archaeologists of the work of those French historians including Fernand Braudel, Emmanuel LeRoy Ladurie, and Jacques Le Goff that has come to be known as the Annales school of history (see, for example, Braudel 1973, 1977, 1981, 1982, 1984; Ladurie 1979a, 1979b; Le Goff 1980, 1985; Le Goff and Nora 1985). After literally generations of archaeologists largely ignoring the work of the Annales historians, some archaeologists in the last decade have begun to discuss the possible implications of applying Annales informed approaches in archaeology (Little and Shackel 1989; Bintliff 1991; Knapp 1992; Dark 1995:180).

The conceptualization of an Annales school of history is perhaps too narrow a reading of what has been a diverse group of scholars with considerable differences in their theoretical approaches and methodologies. It also pays little attention to the changing concerns of these French historians over time as they affected, and were affected by, changes in theory and methodology within the social sciences. Richard Bulliet (1992:133) has suggested that “for many historians it [the Annales approach] has seemed less to provide a specific formula to follow than an opportunity to gain a hearing for new and adventurous ideas.” In this respect, one fundamental concern of Annales informed scholarship is an interdisciplinary approach to the past that draws on a variety of disciplines including archaeology, history, anthropology, sociology, geography, and psychology. Christopher Peebles (1991:111) has characterized it as having “an

absence of dogmatism, a certain non-pathological eclecticism, a general commitment to research directed towards the solution of explicit problems, and longstanding efforts to include the methods and products of the social sciences, especially anthropology and economics, as part of historical methods."

A key concept of the Annales approach is Fernand Braudel's three scales of history: the short term—concerned with *événements* (events and individuals or individual time), the medium term—concerned with *conjonctures* (processes or social time), and the long term—concerned with the *longue durée* (structures, world views, *mentalités*, and geohistory) (Braudel 1980, 1982, 1984). The greatest interest among archaeologists has been focused on the *longue durée*, which is usually measured in centuries or millennia, and on the work of Immanuel Wallerstein (1974) on World Systems theory that derives much from Braudel. The concept of the *longue durée* appeals to the long time frames studied by, as well as the anthropological inclinations of, many archaeologists (for example, see Hodder 1987:1-8). Archaeologists have shown far less interest in short term history or the history and archaeology of the event and individual actions. Consequently archaeologists are far less familiar with the work of Emmanuel LeRoy Ladurie or Jacques Le Goff and the writings of the so-called third and fourth generations of Annales historians than they are with the writings of Braudel, the second generation.

Medieval history, on the other hand, has been far more accepting of the contribution that archaeology and the study of material culture can make to our understanding of past cultures. It has been the third generation of Annales historians, like the medievalists Jacques Le Goff, George Duby, and Emmanuel LeRoy Ladurie, who have focused interest toward the lives of ordinary people, or what Eric Wolf (1982) has called "the people without history," and in doing so have looked to develop a "historical anthropology" or "ethnological history." In this context, Le Goff (1980:232) has suggested that "ethnology's immediate contribution to history is surely the promotion of material civilization [or

material culture]." He goes on to suggest that one of the first things that a historian will encounter in a search for "the ordinary man who does not—did not—burden himself with a mass of documentary records" is "the archaeology of everyday life, of material life" (Le Goff 1980:234). The work of Annalists like Ladurie and Le Goff has examined the interactions among the three times scales and refocused attention on the event, or the everyday happening, as a valuable source about the way people viewed their world.

Annales Approaches to Archaeology

This paper draws on works that have applied an Annales framework to archaeology to illuminate "wider issues from a specific case" (Jones 1991:96). These works, however, also demonstrate some fundamental differences that exist between archaeologists working in different time frames and in different contexts.

One such work is a chapter by Rick Jones in *The Annales School and Archaeology* (1991) which relates specific events at forts on the Roman frontier of northern Britain to the long term decline of the Roman Empire. Jones (1991:98) asserts that "archaeological evidence is not suited to the reconstruction of specific events" and he goes on to suggest that "individual historical events are at best very difficult to identify in the archaeological record." While this is no doubt true of the archaeology of Roman forts, and many other kinds of archaeology, it is not true of the archaeology of shipwrecks. Maritime archaeology, or at least a very large part of the archaeology of shipwrecks, derives from specific events—in particular, the shipwreck event. At one level, the event can be seen as unique in time and space, the result of the actions and interactions of individuals and groups of people leading up to and including a particular event. Indeed, it is the focus on the uniqueness or singularity of the shipwreck event that in the past has resulted in the critique leveled at shipwreck archaeology as a form of historical particularism. However, it is at the level of the archaeology of the event and through incorporat

ing the event into the longer term and the larger scale (*conjonctures, mentalités* and the *longue durée*) that maritime archaeology has some of its most powerful explanatory value.

Another work which utilizes Annales concepts is a paper in *Antiquity* by Barbara Little and Paul Shackel (1989). Their article looks at the historical archaeology of 18th-century Annapolis, Maryland, within the framework of the long term history of dining etiquette in Western civilization. Shackel (1993:116-117, 143, 152-157) and Johnson (1993:327-356) have also argued that objects associated with foodways or personal appearance and hygiene, such as tooth brushes and hair brushes, can be interpreted both as supporting structures of domination and social differentiation as well as symptomatic of the increased importance placed on individuality and outward appearance in modern society.

Using a similar approach to that taken by Little and Shackel, I am looking at the link between personal hygiene and certain infectious diseases and at the changing social discipline associated with personal cleanliness. Historian Thomas McKeown (1979:45, 76) has concluded that the fall in mortality since about A.D. 1700 was “due predominantly to a reduction of deaths from infectious disease.” He contends that after nutrition, improved hygiene and sanitation played the greatest role in the reduction of mortality in those water and food-borne diseases such as cholera, typhoid, and dysentery. While there is no doubt of the importance of sanitation or public health measures, such as the provision of clean, running water and sewage systems, the part played by changing attitudes to personal hygiene should not be forgotten. The increasing use of chamber pots and the washing of the hands and body using washing bowls also played a part in reducing the incidence and spread of certain diseases.

Current research on the Chinese export porcelain cargo of the merchant ship *Sydney Cove* (1797) has previously considered the dinner wares and tea wares (Staniforth 1996). Part of the ceramic cargo of the *Sydney Cove* wreck site contained toiletry sets consisting of chamber pots as well as washing water bottles and their asso-

ciated bowls (Staniforth 1995:161-163). In order to establish that ceramic items used for washing and personal hygiene were present on archaeological sites, it is first necessary to correctly identify the individual shards. Archaeological assemblages from the 1983 and 1990-1991 excavations at the First Government House site in Sydney have revealed fragments of toiletry ware sets identical to the *Sydney Cove* examples. Classified in the artifact catalogue as an “Oriental porcelain covered bowl” were pieces of a Chinese export porcelain chamber pot. In addition, pieces described as part of an “Oriental porcelain footed bowl” were actually a group of fragments that once formed a washing water bottle or *gugglet*. More recently, a considerable amount of Chinese export porcelain has been excavated from Cumberland Street in the Rocks, Sydney. Among the fragments of plates, bowls, tea wares, and tureens are pieces of identical chamber pots and *gugglets* that came from the securely pre-1815 context of a well on the property of George Cribb, an emancipated convict and butcher.

Conclusion

Sydney Cove was carrying toiletry sets for the newly established colony at Sydney. Shards of very similar individual items that formed toiletry sets have turned up on terrestrial archaeological sites as well, including First Government House and Cumberland Street. Ordinarily, toiletry sets—consisting of a jug, bowl, and chamber pot—have been associated with the Victorian era when they became extremely common. It is interesting that such sets should have been available as early as the end of the 18th century and the first years of the 19th century. It is possible that the consignment of toiletry sets to Sydney may reflect British merchants’ and colonists’ changing ideas about washing and living in hot climates.

It is also interesting that archaeological evidence of toiletry sets should turn up on such different sites as First Government House, home of the early governors of the colony, and a well on the property of George Cribb, a former convict. This evidence indicates that the ownership

and use of objects once considered directly indicative of social status is not always as simple or straightforward as archaeologists like to think.

The archaeology of *Sydney Cove* is an example of archaeology of the event. The wreck was an important historical incident in the early settlement history of Australia. However, material culture from the wreck site also represents an opportunity to incorporate the archaeology of the event into larger scale issues such as capitalism, consumption, and colonization as well as changing cultural attitudes associated with dining, tea drinking, and personal hygiene.

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Ballast in the Port of Veracruz during the Second Half of the Eighteenth Century

*Heavy is the root of light
Quietness governs movement
That's why even traveling all day
The wise man never abandons
The road's beginning.*
Lao Tse (1995:73)

Introduction

"One of the most necessary requirements so that the wonderful machine of the ship might furrow the seas is ballast, consisting of several stones or other heavy items put in the ship's bilge, thus avoiding the danger of sinking" (Archivo General de la Nación [AGN] 1792:3979).

Ballast is one of the few items that almost always can be found with the remains of a shipwreck. The ballast pile often draws attention to the site. Study of the quantity and distribution of ballast has been undertaken to determine the ship's payload and hull shape. Petrographic or geochemical analyses have been employed to determine the point of departure and the history of the vessel's voyages. However, despite the prevalence of ballast on shipwreck sites, not much is known about it from documentary sources. The recent discovery of a document in Mexico's Archivo General de la Nación (AGN 1792) regarding regulation of ballast at the port of Veracruz in Nueva España during the second half of the 18th century provides important information regarding this vital commodity.

Before considering the content of the document itself, it is necessary to briefly explain the organization of the AGN, the genesis of the document, and the importance of the fortress of San Juan de Ulúa to the port of Veracruz.

Together with Spain's Archivo General de Indias (Seville) and Archivo General de Simancas, the Archivo General de la Nación (AGN) in Mexico City is one of the most valuable centers for study of the Hispano-American colonial period. The AGN contains 115 novohispanic documentary groups, 98 of which are cataloged on the compact disc *Argena II*. Documents on *Argena II* are accessed by date, place, or description. The AGN also has other groups of documents with information about the viceregal era. These documents are classified in several collections which are not cataloged on *Argena II*. The Fonseca y Urrutia collection, the source of the document under study, is one such group.

In 1794, upon request of Juan Vicente Güemes y Padilla, second count of Revillagigedo and viceroy of Nueva España, Fabián Fonseca and Carlos de Urrutia completed a study known as the *Historia General de la Real Hacienda* (General History of the Royal Hacienda). Their report contains subjects of nautical interest such as admiralty, *avería* (tax to cover maritime loss), naval fleet, anchorage, *almojarifazgo* (tax on maritime trade), and ballast. Volume 22 contains information about *almojarifazgo* and about existing regulations for buying and selling ballast for ships arriving at the fortress of San Juan de Ulúa during the second part of 18th century.

Veracruz was the most important port in Nueva España and remains the most important port in modern Mexico. Spanish fleets, viceroys, and immigrants to the West Indies arrived in Veracruz. From there, galleons sailed for Spain with cargoes that would supply the court. Opposite the mainland town of Veracruz is the castle of San Juan de Ulúa, where all ships used to dock. In 1518, the explorer Juan de Grijalva discovered the islet where the fortress is presently located and cast anchor to begin the discovery of the Veracruz coast. In 1519, the conqueror Hernán Cortés established a settlement

opposite the islet, naming it Villa Rica de la Veracruz. It was soon moved in an effort to provide better anchorage. Around 1524, the community was transferred again, this time to the shore of the Antigua River, where it stayed for several decades. At the end of the 16th century, Veracruz was reestablished at the very site of its first settling, due to the difficulties the town on the Antigua River had for disembarking goods. The new settlement (on the site of the first settlement) was then known as Nueva Veracruz, and the previous one on the banks of the Antigua River became known as Antigua.

Construction of the fortress at San Juan de Ulúa began during the last years of the 16th century. Building and modifications continued for two more centuries. Thomas Gage (1994:66), an English Dominican who visited the port in 1625, gives the following description of San Juan de Ulúa: "We casted anchors, . . . reinforced them with several cables that were tied to some heavy iron rings that were purposely nailed in to the castle wall in order to protect by these means the ships from the violence of the northerly winds."

The Document: *Estanco de Lastre* (The Ballast Monopoly)

According to the manuscript, ballast stones were acquired in the king's name to be sold afterwards to ship owners. From "time immemorial" (AGN 1792:3979v)—which can be understood as perhaps from the 16th century—the governors of the port of Veracruz were in charge of this negotiation. In 1751 and 1754, some of the port's citizens proposed that they be allowed to bid for the contract to supply ballast and suggested a series of regulations. The proposal to allow citizens to bid for the contract was not granted, but their suggestions formed the basis of a new way to regulate ballast.

In 1770, Carlos III requested that the marquis de Croix, viceroy of Nueva España, submit a brief about the custom by which port governors supplied ballast for war and merchant ships. Apparently the requested brief was never sent, for during 1777, when Antonio María de

Bucarelli was viceroy, the king repeated his request for the brief. The report was sent during Bucarelli's rule, and negotiations for changes in the management of ballast were completed by 1780 under the next viceroy, Martín de Mayorga.

According to the report to Carlos III, when the marquis of Casa Filly arrived in the port of the Veracruz many years earlier, he did not find any royal order that granted the governors the privilege of managing the ballast. The marquis pointed out that the governors' seizure of the management of ballast was detrimental to his majesty and his vassals. In 1756, Francisco Crespo Ortiz, governor of the port, proposed that all rules and necessary conditions for regulating ballast negotiations be sent to Veracruz. However, the viceroy, the marquis de las Amarillas, deemed the ballast trade too important to run through the *Real Hacienda* (Royal Treasury). Such practice would require too many people to keep the accounts, carry the ballast, take care of it, and maintain the needed spare ballast. In addition, it would require royal boats and a number of crew members to carry the ballast. Therefore, the viceroy decided that governors should continue with the practice of managing the ballast trade.

There were no more negotiations about who was to manage ballast until 1780. The port governors continued the practice without anyone knowing the benefits and profits it produced. These profits depended upon the management, the loyalty of the workers and employees, and the number of Spanish ships anchored at the port. Ships voyaging between Spain and the colony were stone-ballasted. The rest of the vessels were sand-ballasted "for their poverty would not permit anything else" (AGN 1792:3983).

On the other hand, the brief sent to Carlos III claimed that if ship owners were allowed to ballast themselves at will, several drawbacks would arise. One drawback would be frequent shortages. These shortages would cause delays in the departure of ships. Preferences would have to be granted to the king's ships, and this preference would cause more problems to other ships unless there was a responsible authority to pre-

vent these damages. Therefore, if the whole proposal was to keep the port governors from controlling the ballast trade, there was no other feasible solution but to auction the ballasting permit by posting bills so that a private party would take it. The conditions and rules by which the supplier should contribute to the royal revenues would be written down

that for some time there would be no lack of such a precious commodity for merchant and warships alike, forbidding any other that was not such purveyor the permission for such deal, and [the purveyor] committing himself to have plenty of spares, granting him for this purpose the dock of San Juan de Ulúa, and if there would cause any harm, some other place of his choice (AGN 1792:3984).

Under these dicta and some suggestions the citizens had proposed in 1751 and 1754, the management of ballast was changed, in spite of the fact that there had been no complaint of lack of ballast when it was necessary and no complaint that ballast was sold to ship proprietors at high prices. This change was sent to Carlos III in the report of 1778.

The king responded that even though there were no complaints about the governors' management of the ballast supply and even though the practice had long been customary, it was not a privilege that the governors should enjoy any longer. The king regarded the practice as foreign to the protocol and duties of governors as military officers in command. The right was not founded on royal authority nor on a court that would legitimate it. In addition, there were laws preventing governors from participating in direct and indirect trade. Consequently, Carlos III precluded the governors of Veracruz from running the ballast business and supported the idea of auctioning the right to a private party. He then instructed the *ministerio de la Real Hacienda* (Royal Treasury ministry) of Veracruz to set the required rules and conditions for its proper management.

The auction bills were to be posted in public places both in Antigua and Nueva Veracruz. The

rules regulating the ballast trade were written in 1779 and stated the following conditions: The price for ballast carried by small service boats belonging to vessels docked at San Juan de Ulúa was to be preserved to allow the supplier to profit without harming the royal revenues. The price for heavy ballast was fixed at 4 pesos per ton of 80 *arrobas* (about 900 kg total) for royal vessels and 5 pesos for merchant ones. The price of *zaorra* (small ballast) was fixed at 8 pesos per ton for the king's vessels and 10 pesos for merchant ships.

Should a ship unload ballast, the owner should return it to the same place in the warehouse and be paid for half of the disembarked tons. The supplier was to insure that the stone supply would not fall below 4,000 tons at any time and not below 6,000 tons when a fleet was expected. The port's captain should be responsible for ensuring that the ballast was stacked in such a way that it would not fall into the water. Due to the supplier's commitment always to have plenty of ballast, other parties were forbidden to engage in the ballast business, whether in small or large quantities.

The supplier of ballast in Veracruz purchased the stones from a ballast wholesaler in the city of Antigua. At the time of the sale, the wholesaler was to pay an *alcabala* (a sales tax) to the supplier. However, if the wholesaler could produce a receipt proving that the tax was already paid, he was exempted. The supplier then had to pay a different *alcabala* in Nueva Veracruz. He could pay 3 percent above the previously set prices when he brought the ballast to Veracruz or 6 percent when he sold it. The supplier had the choice of paying the way he saw fit, whether or not he had received the *alcabala* payment by the Antigua wholesalers.

Neither the ballast wholesalers nor the final supplier would be compelled to make any contribution to the *alcalde mayor* (mayor) of the City of Antigua, and under no circumstances should the *alcalde mayor* interrupt the trade. Therefore, the *piraguas* (pirogues, canoes) carrying ballast from Antigua to Veracruz should

carry no papers other than the waybill that the *alcalde mayor* had given them at the Antigua customs house.

It was prohibited to the ships of Spain, Caracas, and Maracaibo, and to others that should pass by the Bahama Channel, to be sand-ballasted

because of the severe problems that could arise [from sand] clogging the pumps during such a long sailing. Merchant vessels of the Gulf of Mexico do not sail long distances, and for this reason and because of their meager trade, they will be tolerated to sand ballast just like thus far has been the common practice (AGN 1792:3995).

Lastly, the supplier should make a deposit of 6,000 pesos maximum. The deposit covered the contribution he was to make to the *Real Hacienda*. Should he run out of spare ballast, the deposit could be used to acquire ballast at his expense. The permission should last from 3 to 5 years, during which time the supplier would run the ballast trade.

After examining these rules, the *junta de la Real Hacienda* (Royal Treasury assembly) modified only the prices: large stone for the king's ships was to sell at 3 pesos and 4 reales per ton, and *zaorra* at 7 pesos. The price for the merchant ships was lowered to 4 pesos 4 reales for large ballast and 9 pesos 4 reales for *zaorra*. A new restriction was also added: should any merchant ship unload ballast because of the payload it was to receive for the return trip, the owner could not give the ballast away nor sell it to someone else who might need it—not out of friendship or for any other reason—but he could sell it only to the supplier.

In December 1779, in spite of all this planning, not a single bidder offered to assume the responsibility of the ballast trade after the auction was made public. As a result, in January 1780, it was ruled that the ballast trade was to be managed by the *administrador de la Real Hacienda* (administrator of the Royal Treasury) in Veracruz. The *administrador* would have an

assistant as ballast supply officer, who was to observe the previous rules in addition to the following modifications.

The ballast supply officer would have an annual salary of 500 pesos, having to put down a deposit of 2,000 pesos in order to commence his duties. He would be subordinate only to the *administrador de la Real Hacienda*. Considering the transport expenses and the difficulty in taking the ballast past the Antigua sand bar throughout the year, the ballast officer would be allowed 1,000 pesos to pay operators of *piraguas* for transporting the ballast to the dock of the fortress of San Juan de Ulúa.

He would not deliver any ballast load without written permission from the *administrador de la Real Hacienda* and would take the receipt to the treasury, so the office of the *Real Contaduría* (Royal Accountant) would have the corresponding accounts. The ballast loaded on royal ships would be debited from the *Real Hacienda* account at the rate of 3 pesos per ton. The debit from the *Real Hacienda* account was to apply to mail ships also and to ballast that the city needed for paving.

Even though freight vessels had been steadily paying 5 pesos per ton, the rate was to be reduced to 4 pesos, providing that this reduction would not turn out to be too costly to the *Real Hacienda*. By the end of each month the ballast supply officer was to give the officer of the *Real Hacienda* a list of the tons for which he had been paid, another list detailing what remained of the 1,000 pesos he had received at the beginning to pay *piraguas* operators to transport ballast, and a list of the total ballast stock under his responsibility. This latter account was to prevent any shortage of ballast stock.

Last among these resolutions, finally prepared in February 1780, it was ordered that no ship would be forced to load ballast when it did not need it. In addition, the port captain should see that all vessels departed properly ballasted.

This series of manuscripts concluded with a king's resolution dated 1788. In response to a

request from several captains of ships docked at Veracruz, the king allowed them to use sand ballast in lieu of whole stone and declared that any ship sailing to whatever port of America or Spain could load the ballast of its choice "without being tied with these restrictions that remarkably damage the trade" (AGN 1792:4013). The king's decision is notable given that a few years before so much care had been taken to preclude the use of sand ballast because of its tendency to clog the ship's pumps during long journeys and thus endanger the vessel. Once again, the interests of the crown were founded more on the urgency of economic profits rather than on the safety of the fleets and ships. Such emphasis on profit over safety was not a singular occurrence, as evidenced by the hasty departures and sailing out of season—despite regulations to the contrary—that caused so many shipwrecks.

The importance of ballast to a sailing ship confirms the epigraph that headlines this text: heavy ballast is the root of the balance between the buoyant lightness of the hull and the force of the wind upon the ship's sails; the stillness of the stone controls the ship's motion; and in spite of many long journeys, a vessel is forever tied to the port from which it departed. A Spanish

cliché for ballast is "to drag," i.e., to prevent or hinder motion, but indeed ballast can mean quite the opposite: the root of balance and motion.

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The Conquest of a Sinkhole: Initial Archaeological Investigations at El Manantial de la Aleta, East National Park, Dominican Republic

Introduction

Manantial de la Aleta (Spring of the Fin) is the name applied to a limestone sinkhole in the province of La Altagracia in the easternmost part of the Dominican Republic. It has been a noted feature since the time of the Spanish conquest in 1503. The archaeological site has been known to contain a prehistoric plaza and surface artifacts (Guerrero 1981), but until very recently, the sinkhole was unexplored except by native divers who had retrieved several dozen artifacts in bounce dives to the bottom. Concern for a proper assessment of the site and its future management led Pedro E. Morales Troncoso, President of the Patronato Rector for East National Park (Parque Nacional del Este), to arrange for initial studies in 1996.

Site Location and Description

Manantial de la Aleta is situated within East National Park some 7 mi. from the eastern coast (Figure 1). The landscape surrounding the sinkhole is flat limestone rock with many cracks and solution cavities. The site area is heavily covered with tropical vegetation described by Las Casas (1967) in the first decade of the 16th century.

The sinkhole itself is a dramatic feature. Seven "eyes" or cavities have been formed in the surface rock over a 30-ft.-diameter area. The largest measures only 6 x 9 ft. but affords a dramatic view of a subterranean chamber dropping 50 ft. to the water level (Figure 2). About 34 ft. below the clear spring water surface, a yellow sulfur layer blurs visibility. The water clears again at 65 ft., and at 113–115 ft., the top of

the cap rock protrudes from a dark liquid silt containing numerous artifacts.

The sinkhole chamber is basically circular, measuring 121 ft. (north-south) x 140 ft. (east-west). The sides of the hole drop gradually away from their perpendicular orientation at water level and bell out in every direction. At the perimeter of the cavern, the water depth ranges from 122 to 139 ft. but slopes downward to a depth of at least 240 ft.

Historical Background

Manantial de la Aleta is the only reliable water source for many miles in any direction. That fact explains why it has been noted since the time of the chronicler Bartolomé de las Casas. He estimated it to be "half a league" from the village of the great Taino *cacique* Cotubanamá and "4 to 5 leagues from the sea" in the southern part of the province of Higüey (Las Casas 1967:24). This description matches the approximate location of La Aleta.

A further historical note is provided by Las Casas. The chronicler must have seen the site to describe taking water from it. He says the spring had "half a league of width, perhaps all of it below ground" with a mouth only 8 in. squared.

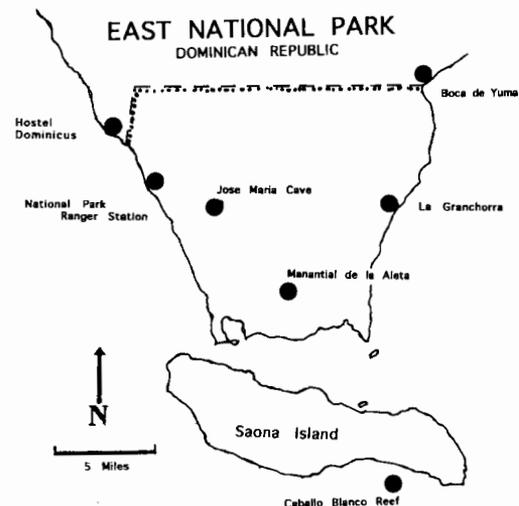


FIGURE 1. The location of Manantial de la Aleta within East National Park.

Here he may have been referring to one of the small "eyes." He notes that in order to drink the water—sweet above and salty as one goes deeper—the Taino used a piece of rattan as rope and "an earthenware cup" to take out potable water at about 8 arms-length of depth (Las Casas in Guerrero 1981:2). This description matches the approximate distance needed to reach water from the surface opening at La Aleta.

The Higüey district in general, and the Aleta site in particular, played a significant role in the history of the conquest of Española. In 1502, the Taino of this district lived in uneasy peace with the Spaniards who had extended dominion over most other districts on the island. In that year, a party of natives was loading casaba bread from Saona Island under the supervision of the Spaniards. As a demonstration, one of the captains unleashed his mastiff, which horribly disemboweled the Taino leader. This event sparked a general uprising in the province.

A few months later the Indians had their revenge. Governor Ovando sent a caravel to found a new colony at Puerto Plata, and it came ashore at Saona Island. The mariners were set upon by Taino attackers and all but one was slain (Helps 1900:136). When the news of the attack arrived at Santo Domingo, a force of 400 men under the direction of Captain-General Juan de Esquivel was sent to subjugate the Taino of Higüey. The Tainos were led by their great *cacique* Cotubanamá. Although they fought bravely, they were no match for Spanish cannon, horses, and steel. The war became a hunt, and the natives were mutilated and murdered with absolute cruelty. The productive farms and villages on Saona Island were razed (Las Casas 1971:94).

The Taino sued for peace, and it was agreed that Higüey would establish a large plantation to produce casaba bread for the Spaniards. In return, the Taino would be allowed to live in peace. The natives must have considered the agreement important because following the Taino custom, the two leaders exchanged names and became *guataios*—friends and brothers forever. From that time on, Cotubanamá was called Juan

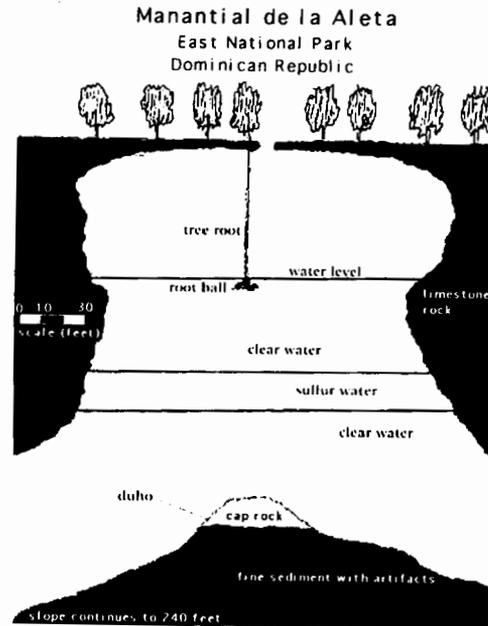


FIGURE 2. Profile of Manantial de la Aleta.

de Esquivel and Juan de Esquivel became Cotubanamá. A perpetual bond of kinship and confederation was established between two worlds (Las Casas 1971:95).

Peace lasted less than a year. Taino warriors attacked a small Spanish fort charged with collecting casaba bread. Las Casas (1971:116) attributed the provocation to general disorder and licentiousness. Whatever the cause, Ovando proclaimed a second war and gave the command to Juan de Esquivel. His army of 300 to 400 men pursued and murdered Taino men, women, and children. The result was another rout of the Indians and massacre of the population. The exact site of this decisive battle has yet to be determined, but it may have been at La Aleta (Elpidio Ortega and Abelardo Jiménez Lambertus 1996, pers. comm.).

Field Methods

Underwater archaeological studies to date have involved mapping, video and still photography, and limited test excavations. A Photographic Imagery Technique (PIT) was applied to map the

deposit. Mapping was done by measuring all objects and features from a datum established on the cap rock. Artifacts visible on top of the cap rock and on the adjacent submerged deposit were mapped using a bearing and distance measurement from the datum. The depth of each was also noted to provide a three-dimensional provenience. Other artifacts on the bottom were marked with pin flags and mapped before they were removed. Depth measurements allowed for the preparation of a subsurface contour map. Detailed mapping was accomplished with a 5-ft. grid constructed of PVC pipe.

Results

Artifact provenience measurements revealed a rich deposit centered around the cap rock (Figure 3). On top of this 20-ft.-diameter rock pile were the shattered fragments of many pottery vessels. Only a sample was collected, but many were undecorated water containers. Other ceramics, wooden artifacts, gourds, baskets, and lithics were found protruding from the sediment near the cap rock. This shallowest area of the under-

water deposit—directly beneath the largest opening—has a high concentration of cultural material.

A large concentration of complete or nearly complete pots was discovered at a depth of 125 to 130 ft. to the northwest of the cap rock. Several were found in loose sediment; others were trapped in rock rubble. An area about 64 ft.² was thoroughly searched with very productive results.

Ceramic Vessels

Fourteen specimens complete enough for typing and identification were recovered. All are stained dark black from immersion in the black humus at La Aleta. Based on shape, the pottery can be separated into 11 bowls and 3 water containers. The bowls are similar to those known from archaeological sites in the Higüey region except that they are highly decorated. Most have incised rims, applied anthropomorphic designs as lug handles, or both. The lug handle of one bowl contains a rattle. Bat faces are the most common decorative form. One small bowl, intact except for a broken neck, contained marine shell fragments.

One intact pottery bowl (MLA #12) is exceptional. It has a distinctive recurved profile and has been repaired with a resin patch, still holding after many centuries. Its shape exhibits Spanish influence. The vessel was recovered and its contents preserved for future analysis.

The water containers are represented by neck and shoulder fragments. One vessel seems to have been the double neck type commonly found in the region. Another (MLA #17) has a phallic neck. The third (MLA #6) consists of the broken neck and shoulder of a large vessel. The shape, design, and decoration match a complete, heart-shaped jar known as a *potzia* in the regional museum of archaeology, Altos de Chavón. It has a phallic neck with a circular inscribed design, a bulbous head, and nipples on the heart-shaped shoulders. This type of pot is very rare and “probably had a ceremonial function” (cf. Fundación Centro Cultural Altos de Chavón 1992:26; Krieger 1931:Plates 9, 10).

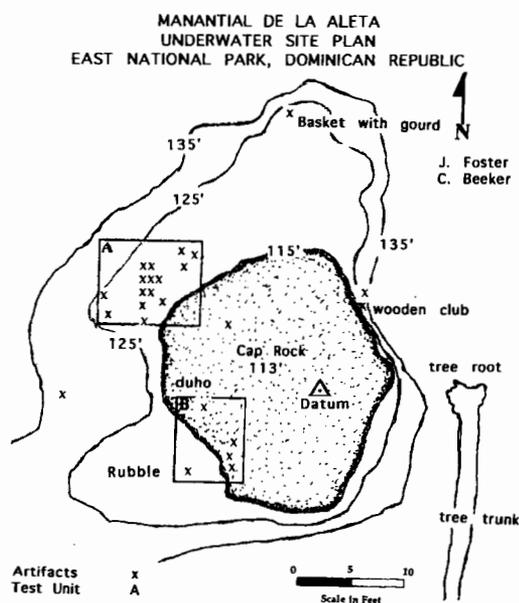


FIGURE 3. Archaeological site plan of Manantial de la Aleta.

Wood Artifacts

Four wood artifacts were recovered from La Aleta. The most significant is a fragmentary, burned *duho*, the ceremonial stool used by Taino royalty at all public events. The recovered specimen was found on the cap rock in test unit B at a depth of 115 ft. It is a simple, undecorated seat carved from a single hardwood piece. Only one leg has survived, so its original form is unknown.

A wood sample from the *duho* was submitted for radiocarbon dating. It was determined to be 620 ± 80 ^{14}C years B.P. (Beta Analytic 96781, burned wood). *Duhos* are very rarely found in archaeological contexts and are assumed to be associated with Taino *caciques* or members of the royal family. They pertain to the Classic Taino culture (Rouse 1992:130).

A wooden club (MLA #23) was found in the sediment under a ledge of the cap rock at a depth of 126 ft. It measures almost 15.75 in. (40 cm) in length with a diameter of 2 in. (5 cm) at the proximal end. The club has a handle like a baseball bat and a thick distal end. It has been shaped from a hardwood, with individual adz marks clearly visible, and has no perforation for attaching a stone celt.

A carved wooden sphere (MLA #5) measuring 1.6 in. (4 cm) in diameter was also recovered. It has individual adz marks. Its function is unknown. A 9.8-in (25-cm) segment of hardwood log was also recovered near the cap rock. Although individual scars from adz marks could be clearly seen, the item was apparently unfinished.

A large, oval-shaped, wooden bowl (MLA #22) was recovered in perfect condition from bottom sediments at a depth of 124 ft. It is fashioned from a single piece of wood and ground into shape. No decoration was observed on it, but it is intact and may have been a serving container.

The Faro a Colón museum in Santo Domingo has conserved two hatchet handles from La Aleta. These were recovered by native divers within the last 2 years. They are similar, shaped by adze blows, and have an oval hole drilled in their distal end to accommodate a stone celt or

hacha head. Mixed wood fragments from these hatchet handles were submitted for radiocarbon dating as a single sample. They were determined to be $800 \pm$ ^{14}C years B.P. (Beta Analytic 96782, wood).

Gourds

One of the most striking examples of artifact preservation in the submerged deposit at La Aleta is in the number of gourds present. These gourds (*higueros*) are the fruit of a large tree, *Crescentia cujete*. They have been fashioned into canteens, bowls, and simple containers. In one area to the southwest of the cap rock, a large tree has come to rest at a depth of 165 ft. across the sloping bottom. It has formed a debris dam and trapped many *higueros* in the accumulated sediment. They show considerable variety in form and function. Some were apparently used to dip water from the well as they have the rattan rope still tied around them. Others were cut to form shallow bowls and perhaps storage containers.

A striking *higuero* fragment (MLA #8) was recovered from a depth of 126 ft. in test unit A. It is an incised specimen with a polished exterior. The spiral design is intricately formed and exactly executed. The gourd was cut, polished, and apparently suspended by line through holes drilled through the rim. It may be the first example of its kind found in an archaeological context in the Caribbean (Elpidio Ortega 1996, pers. comm.).

Basketry

A single fragment of twined basketry was mapped on a ridge of sediment north of the cap rock at a depth of 125 ft. It has been pierced by wood debris, and, due to its fragile condition, recovery was not attempted.

Lithics

A single celt fragment was recovered from the deposit (MLA #24). It is bifacially ground and polished. The material may be serpentine. Six

others reportedly derived from the site include complete examples of a teardrop shape. They were possibly hafted to wooden clubs when deposited in the sinkhole.

Interpreting Taino Uses of Manantial de la Aleta

Manantial de la Aleta demonstrates the Taino practice of making ceremonial offerings in this underground lake. Although some pottery vessels were water receptacles, many were highly decorated food bowls or containers. One vessel held fragments of marine shell. According to Ramón Pané (translated in Bourne 1907:326), the Taino dead were believed to live in a parallel world. They feasted and dined with the living. Food offerings and ritual depositions were probably made at the site.

Is Manantial de la Aleta a Taino *cenote*? No archaeological evidence of human sacrifice was recovered and no human remains were seen, but the sinkhole served the same function as those in Mesoamerica where ceremonial offerings were made to the deities. This site can be interpreted as having an equivalent function in Taino culture. Ancestors needed to be properly greeted and cared for by living relatives. They emerged from caves and underground holes to feast and go with the living (Ramón Pané translated in Bourne 1907:326). A focal point for this activity for the province of Higüey seems to have been El Manantial de la Aleta.

The fragmentary, burned *duho* recovered from La Aleta is an important clue to the sinkhole's function. Because the simple carved wooden stool was used by *caciques* and royalty at ceremonial events, the Spaniards considered the *duho* a symbol of the Taino rulers. Its presence in the sinkhole strongly implies a sacred nature for La Aleta. The presence of hatchets, stone implements, finely made ceramic vessels containing food remains, heart-shaped phallic jars, an incised *higuero*, and a lug rattle strongly supports the interpretation that the site was used for ceremonial offerings. The Taino had few personal possessions, but developed elaborate rituals

and paraphernalia for their ceremonial life (Barreiro 1992). Radiocarbon analysis of wood fragments from the *duho* and hatchet handles demonstrates use of the site for about 5 centuries before the conquest. These dates fit comfortably with the pottery types. A single vessel may demonstrate Spanish influence during the contact period.

Based on preliminary examination of artifacts recovered and review of descriptions of Taino culture, Manantial de la Aleta should be considered one of the most significant archaeological sites in the Dominican Republic. It has the potential to reveal considerable details about Taino ceremonial life and provide new insights into the ritual behavior of an extinct culture. Preservation conditions are excellent. The site needs to be protected against any further artifact removal until proper scientific studies can be made. This site has great significance to the people of the Dominican Republic and to all who want to understand the people who "discovered" Columbus—the Taino.

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Underwater Cultural Resource Management: A New Concept in the Cayman Islands

A Definition of Underwater Cultural Resource Management

Following is a reexamination of the concept of cultural resource management (CRM). Previously, this author viewed underwater CRM as a regulatory tool by which federal and state government departments, under legislative mandates, managed prehistorical and historical archaeological sites, including shipwrecks, located within their jurisdictions. In recent years, while living outside the United States, the author's concept has broadened to include all entities which take action to protect underwater cultural heritage. Responsible action can be taken by professional organizations, governments, government departments, academic institutions, nonprofit organizations, museums, avocational groups, individuals, or partnerships of the above. In short, all those who influence or participate in professional underwater archaeology are involved in cultural resource management. And teamwork reaps the best rewards.

Professional organizations, including the Society for Historical Archaeology, are broad in scope and geographical coverage. They set ethical standards and influence legislative efforts as well as issues regarding specific sites. Governments hold the power for legal control of archaeological sites located within their jurisdictions, but they can be slow movers in exercising protective measures. When governments are lobbied by opposing viewpoints, success in achieving preservation goals can be hard won. Government departments, academic institutions, nonprofit organizations, and museums support scientific research into sites, provide professional expertise, may attract funding, and can educate the public. Avocational groups provide enthusiasm and a willing work force. Their participation increases public understanding of archaeology. And

individuals are often the most personally involved in regional archaeology, working hard to gain the ear of governments and to attract professional assistance to achieve preservation goals.

Although there are still many who destroy cultural resources, more people and countries are developing a sensitivity and taking positive action to protect underwater archaeological sites. International initiatives—including the Buenos Aires Draft Convention on the Protection of the Underwater Cultural Heritage, prepared by the International Law Association and submitted to UNESCO in 1995, and the ICOMOS Charter on the Protection and the Management of Underwater Cultural Heritage, ratified in Bulgaria in October 1996—attest to a global interest in preservation of the world's fragile, irreplaceable, and limited submerged heritage.

Among actions that might be taken to protect underwater heritage are: (1) establishing protective legislation; (2) mitigating impacts to endangered sites; (3) preventing destruction of sites and dispersal of artifacts by denying permits to exploiters seeking private financial gain; (4) creating local, national, and international inventories so that sites can be managed; (5) protecting and interpreting shipwreck sites in situ as underwater preserves whenever possible; (6) excavating sites only when there are scientific objectives, adequate funding, professional staff, and provisions for documentation, conservation, curation, and reporting; (7) involving the public so that people become guardians of their heritage; and (8) bringing the excitement of shipwrecks and other underwater sites to the public in reputable museum exhibitions, media presentations, and publications.

Underwater Cultural Resource Management in the Cayman Islands

The Caribbean is rich in maritime prehistory and history. It was a crossroads of shifting colonial power and waterborne commerce among European nations, particularly Spain, England, France, and the Netherlands, from the close of the 15th through the 19th centuries. Maritime archaeological sites include prehistoric and his

toric coastal settlements, forts, lighthouses, ship-building sites, ports and harbors, as well as shipwrecks and related contemporary salvage sites. Archaeological remains include ships of exploration and discovery, treasure galleons, slave ships, craft of pirates and privateers, merchantmen, warships, and local vessels.

The Cayman Islands are a British Dependent Territory, located amid the Greater Antilles in the western Caribbean Sea. From the mid-17th century, the three islands (Grand Cayman, Little Cayman, and Cayman Brac) had a continuing, if somewhat loose, association with Jamaica. In the age of sail, they lay along the track of the important route by which ships journeying from the east would follow prevailing wind and ocean currents to exit the Caribbean through the Yucatan Channel, enter the Gulf Stream, traverse the Straits of Florida, and sail up the eastern coast of the United States then past Bermuda for the return voyage to Europe. Cayman's location, combined with the islands' low elevation and treacherous fringing reefs, contributed to the loss of many ships over the course of 500 years. In the Cayman Islands, a distinctive maritime heritage evolved and lasted into the 20th century, including turtle fishing, shipwreck salvage, rope making, and shipbuilding among other industries.

Steps in the Preservation of Cayman's Underwater and Maritime Cultural Heritage

The first people to impact Cayman's shipwreck resources were the survivors who salvaged their own ships and island residents who benefited from obtaining lost cargos and ship-related items. Once contemporary salvage ceased, the wreck sites lay largely undisturbed by humans until the mid-20th century. With the advent of SCUBA and beginnings of island tourism, early diving enthusiasts exploring the warm clear waters of the Cayman Islands impacted archaeological sites.

In response, the Abandoned Wreck Law, assuming Crown ownership of abandoned wrecks of 50 years of age and older, was enacted in 1966 to ensure that the Government of the Cayman Islands receives a percentage of the value

of shipwrecks recovered from Cayman's territorial seas. Government has never issued a license under the Abandoned Wreck Law, which, in spite of its shortcomings regarding salvage, has officially prevented treasure hunters from working in the Cayman Islands. The law has not discouraged illegal activity or souvenir hunting on shipwreck sites.

The Government of the Cayman Islands first invited assistance from professional underwater archaeologists in 1978. Between 1979 and 1980, the Institute of Nautical Archaeology (INA), based at and affiliated with Texas A&M University, conducted an underwater survey of Little Cayman, Cayman Brac, and Grand Cayman to locate and evaluate the islands' shipwreck resources. According to project director Roger Smith (1981:viii), members of INA initiated the Cayman Islands Project, their first archaeological research in the Caribbean, "not only because of the obvious need, but also because they believed the survey might provide an example to other West Indian nations of how scientific scrutiny, rather than the hunt for treasure, can bring aspects of national heritage to light." Seventy-seven archaeological sites were recorded, including the 17th-century Turtle Wreck, an English turtle-fishing vessel thought to have been burned in 1670 by Spanish privateer, Manuel Rivero Pardal; the Careening Place, a rich site in use from at least the early-18th century; possible remains of vessels lost in the 1794 Wreck of the Ten Sail; 19th-century ships; and 20th-century wrecks. Smith's archival research also revealed the names of ships still to be found, such as the Dutch West Indiaman *Dolphijn*, lost in 1629; the British sloop-of-war *Jamaica*, wrecked in 1715; the pirate ship *Morning Star*, run aground in 1722; and the Spanish brigantine *San Miguel* lost in 1730.

In the mid-1980s, Indiana University's Department of Physical Education, Scuba Research and Development Group, under the direction of Charles Beeker, conducted noninvasive fieldwork on Cayman's East End shipwrecks. During three field school projects in which nautical archaeologists taught sport divers the fundamentals of underwater archaeology, the Group studied sites

previously recorded by INA and succeeded in locating several new sites.

Meanwhile, a law established the Cayman Islands National Museum in 1979, and Anita Ebanks was appointed the first Museum Officer in 1984. In 1990, this author returned to Cayman in time to assist in preparations for the official opening of the Museum.

Between 1990 and 1993, Texas A&M University and the Museum helped support this author's dissertation research, including archival work, folklore studies, and archaeological investigations on the Wreck of the Ten Sail (Leshikar 1993). The disaster involved HMS *Convert* and nine vessels of a 58-ship merchant convoy, homeward bound to Great Britain from Jamaica. All were lost on Grand Cayman's eastern reefs on 8 February 1794, during the French Revolutionary Wars (1792–1802). The frigate *Convert*, formerly *l'Inconstante* of France, had been captured off Santo Domingo in November 1793 and remained outfitted with much original equipment, including the primary ordnance of French 12-pounder cannons.

The Museum and this author found each other at a time when an association proved mutually beneficial. The author was able to conduct research under the Museum's auspices, while the resulting body of data formed the basis of the Museum's 200th-anniversary exhibition, which opened in February 1994, commemorating the Wreck of the Ten Sail. The exhibition was an opportunity to bring archaeology into the public eye in the Cayman Islands. It demonstrated to residents that there is value in understanding our history and that such displays yield benefits to tourism. Government officials were pleased to bring Her Majesty Queen Elizabeth II and His Royal Highness Prince Philip to see the exhibit during their visit to Grand Cayman.

Meanwhile, the Museum worked with other organizations to interpret and bring the event to the public in a Philatelic Bureau stamp issue, a Currency Board commemorative coin, a National Archive Publication, student and adult level Visual Arts Society art competitions, public lectures, and radio and television appearances. Sale of a limited edition of signed posters depicting

the first-place winner of the art competition provided the Museum with U.S. \$10,000 for future underwater archaeology.

Also in 1994, Government formally recognized the importance of historical wrecks when a land based park was created at East End, providing a view of the reefs where the Wreck of the Ten Sail occurred. Minimal excavations of the archaeological sites were undertaken, surface artifacts were mapped, and controlled collections were made. Pending adequate conservation facilities, future archaeology is planned. Concerned people are also working toward protection of the wreck sites and associated terrestrial salvage campsites, as they constitute a significant cultural heritage zone. It is hoped that by educating island residents through many venues, we will have their support when we seek to enact a new law.

During the early-1990s, faced with applications from prospectors who wished to salvage Cayman's historical shipwrecks, the Ministry of Culture formed the Marine Archaeology Committee to advise them and to review and comment on bringing the existing legislation up-to-date. The Committee reviewed the Abandoned Wreck Law, conducted detailed inquiry into current international experience, ethics, and legislation, and concluded that the present law is inadequate and should be replaced. By 1994, they came up with a list of points to be included in a new law. In 1996, the Executive Council of Government officially granted permission for the Cayman Islands' legal drafter to begin work in this area. Meanwhile, the Marine Archaeology Committee has been successful in influencing Government not to issue permits to salvagers under the present law.

By 1993, the Museum employed a full-time professional archaeologist to preserve the Cayman Islands' underwater and terrestrial cultural resources. The inventory the INA team had compiled 10 years earlier was used to form the core of the National Shipwreck Inventory that is archived and being enlarged by the Museum. For example, archaeological work on the Wreck of the Ten Sail resulted in documentation of 30 underwater sites and 8 terrestrial sites within a

3-mi. zone at Grand Cayman's East End, expanding the 1980 INA work. Although another intensive survey of all three islands should be undertaken, new sites are still being found. Recently, another late-17th-century wreck was found in the shallow reefs of Little Cayman. In Grand Cayman, an early-18th-century Spanish wreck, a mid-18th-century British merchantman, and the probable remains of the 1715 wreck of HMS *Jamaica* have been discovered.

Currently, however, the Cayman Islands Government employs only one archaeologist. Hence, much of the underwater work that should be done lies dormant. While this situation is frustrating, terrestrial needs have diverted the Museum's attention. Since the Crown claims ownership of historical sites on the seabed, affording them some protection, recent attention has been given to creation of an inventory of terrestrial sites, many of which are being impacted by Cayman's fast-paced development. The Institute of Archaeology, University College London, conducted cooperative projects in 1992 and 1995 with the Museum, involving surveys for prehistoric sites on all three islands and testing on Cayman Brac. The Florida Museum of Natural History conducted an intensive prehistoric survey of Grand Cayman in 1993. Both groups obtained negative results, suggesting that the Cayman Islands, like Bermuda, were not occupied prehistorically by indigenous people. Thus, Columbus may actually have discovered the Cayman Islands when he passed by on 10 May 1503. Additional delays in underwater work have been caused by the need to put order to numerous collections of archaeological materials turned over to the Museum before this author's employment. The task was undertaken with a core of dedicated volunteers and involved site identification, creating files with documentary forms, plotting sites on maps, and processing, cataloging, and curating artifacts.

Currently, archival and nonintrusive archaeological research is being conducted by an undergraduate field school program from Ball State

University, under the direction of John Dorwin, on the 1930 wreck of the schooner *Geneva Kathleen*. It is planned that their work, in conjunction with oral history and archaeological studies undertaken by Museum volunteer Jeanne Masters, will result in a Museum exhibition and publication.

Our most important future goal for scientifically investigating the underwater cultural heritage of the Cayman Islands is to attract qualified nonprofit organizations and academic institutions with graduate level programs, perhaps Texas A&M or East Carolina University, to develop cooperative programs with the Museum for investigation and conservation of Cayman's shipwreck sites.

In 1996, the Museum participated with a water sports operator to prepare an informational brochure for tourists and a snorkeling maritime history lesson for Caymanian students on the wreck of the *Cali*. Discussions with other operators suggest that the Cayman Islands Water Sports Operators Association will be enthusiastic about working with the Museum to protect and interpret shipwreck sites. Cooperation makes sense for preserving sites and for educating island residents and those whose livelihood is tourism based.

In addition to our efforts in the Cayman Islands, the National Museum has provided information to individuals and governments from other Caribbean countries regarding protection of underwater heritage sites. At the 1995 meeting of the Museums Association of the Caribbean, a workshop entitled "Protecting Archaeological Sites Underwater: Tools for the Caribbean" was conducted, providing participants with a notebook of data to reference for the protection of sites in their own countries. People from the Cayman Islands, Jamaica, the Turks and Caicos Islands, Bermuda, Puerto Rico, Anguilla, St. Kitts, Nevis, Guadeloupe, Dominica, Martinique, St. Lucia, Grenada, Barbados, Trinidad, Mexico, and the United States received copies. A network to keep the International Association for Carib

bean Archaeology, the Museums Association of the Caribbean, and the Caribbean Conservation Association abreast of developments in underwater archaeology in the region has also been established.

Conclusion

In the Cayman Islands, we have made progress in educating government and the public, but there is still much to do. We are working toward improved legislation while using our existing law to its best advantage. We are preventing the destruction of sites by treasure hunters while seeing shipwreck coins from outside our waters sold in Cayman's shops. We are creating a national shipwreck inventory; conducting scientific research into selected sites with the assistance of avocationalists; inviting archaeological and conservation assistance from qualified organizations, graduate level institutions, and researchers; encouraging cooperation of the diving community to protect and interpret sites; bringing the fruits of our labor to the public in museum ex-

hibitions and publications; and encouraging other Caribbean countries to take responsibility for their underwater heritage. Protecting underwater heritage in the Cayman Islands, like many worthwhile endeavors, requires 1 percent inspiration and 99 percent perspiration.

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Problems and Progress in the Turks and Caicos Islands

In 1852, a hard-hat diver named Jeremiah Dennis Murphy took up residence on Grand Turk and fitted out a schooner for diving and salvage. For those who consider themselves pioneers in underwater exploration in the Caribbean, it may come as a surprise to learn that Jeremiah salvaged shipwrecks on Silver Shoals, explored the sunken city of Port Royal, Jamaica, cleared the harbor of St. Thomas after the terrible hurricane of 1867, and undoubtedly prospected for wreck sites closer to home (Sadler 1986[1970s]:27). Today, little of Murphy remains on Grand Turk—a pair of lead diving boots and a three-cylinder air pump that may once have been his.

Jeremiah died 101 years ago (his tomb can still be seen in an overgrown churchyard), but if he were able to walk the streets of Grand Turk today, he would recognize much of it. If, for example, he were to stop at the corner of Front Street and Murphy's Alley, which of course was named for him, he would recognize the large stone building on the corner with the enormous guinep tree out front. Today, the Guinep House, as it is called, is home to the Turks and Caicos National Museum. Founded in 1990—after the tumultuous decade of the 1980s during which there was little appreciation for the colony's rich past or enforced regulations to protect its heritage—the museum symbolizes the progress made toward preservation and away from exploitation.

My personal experience in the Turks and Caicos goes back 16 years, to 1980, when I was sent to have a look at a very old shipwreck on what the locals call Middle Reef but the maps call Molasses Reef. Those 16 years have seen an enormous change in awareness of and protection afforded to archaeological sites in the Turks and Caicos, both terrestrial and underwater, but not as the result of new government policy or the hiring of a cultural resource manager. No, the

change was wholly initiated, paid for, and carried out by a tiny cadre of private individuals—citizens, expatriates, and sympathetic foreigners—who managed: (1) to establish a privately founded and funded national museum fully sanctioned and recognized by the government, (2) to facilitate legitimate terrestrial archaeological field surveys, excavations, and research projects all over the Turks and Caicos, (3) to establish a review process for proposals to conduct shipwreck salvage or archaeological excavations, (4) to initiate research projects in U.S., Bahamian, British, and French archives, and (5) to locate, examine, and record several collections of artifacts removed from the islands in the last century and now residing in various U.S. museums. All of this was accomplished without fanfare and largely in an atmosphere of indifference on the part of the government, the media, institutions of higher learning, and the population at large.

In order to understand just how big a change these accomplishments represent, it is necessary to know what passed before. The British Crown colony known as the Turks and Caicos Islands is mostly water. The population of Grand Turk, the island that has always been the seat of government, is smaller now than it was throughout most of the last century when salt raking was highly profitable. Two of the largest islands in the Caicos group, East and West Caicos are totally uninhabited. It is a small country, and that has been a key factor in what has transpired there.

During the last 2 decades, the islands' shipwreck resources attracted the interest of three superficially identical but in reality distinctly different groups: sportsmen-salvors, schemer-salvors, and dreamer-salvors. Like the Blind Men and the Elephant, each of these groups had a clear appreciation of a small part of what could be done with a shipwreck, but each was woefully lacking in understanding of the entire animal.

The best example of sportsmen-salvors in the Turks and Caicos was the team of Peter Benchley, author of *Jaws*, Stan Waterman, world-famous underwater cinematographer, and Teddy Tucker, charismatic and successful Ber

mudian salvor. In 1977 and 1978, this team mined the waters around Providenciales, one of the islands on the Caicos Bank, for shipwrecks, finding 34 according to Benchley. Exactly what happened, what they found, and where they went is unknown. Benchley described it like this:

Teddy Tucker, Stan, and myself found some wonderful stuff on an 18th-century wreck off Providenciales, including 28 cannons, guns, one Spanish coin and a variety of artifacts. We took only about 10 percent of our find and left the rest on the dock with instructions on how to cure and preserve the pieces. We never knew what happened to all of it . . . nobody seems to (Currie 1984:68).

Actually, Mr. Benchley, we *do* know what happened to it: Roger Smith and I saw and photographed it stored forlornly in a government warehouse in 1981. Benchley got his best-selling yarn *Island* out of the time he spent in the Turks and Caicos. Tucker got half of a small bronze shot mold. We know it came from a wreck on Molasses Reef because a few years later, we found the other half!

They bagged their limit and left, like good sportsmen should. The fact that they plundered a historically important shipwreck site, discarded 90 percent of what they dragged up, and kept the remainder for mantel and coffee table decorations never entered their minds as wasteful or unethical.

Sportsmen-salvors typically are well-to-do, adventurous bon vivants who have seen too many *National Geographic* stories glorifying treasure hunting and identifying it with archaeology. Finally one day they say, "I can do that too!" They buy tickets to one Caribbean destination or another, jump in the water, and start hauling things up. Convinced they are doing archaeology, their concept of historical preservation is often murky and contradictory, as this quotation from Benchley illustrates:

Even my friend Teddy Tucker starts his expeditions with [the] statement: 'Christ, I hope we don't find any gold!' What is really exciting, and I hope someday I'll have this experience, is to find some artifact of incredible historical significance—like the emerald cross

Tucker found in Bermuda some years back. That, more than anything else, is what excites me about diving. There's always that hope of a major find. If you're going to find treasure of great value, hope it's something historically important (Currie 1984:68).

It's not that the sportsman-salvor needs money. Again, Benchley says, "I am no submarine soldier of fortune. . . . After all, I don't exactly need money" (Currie 1984:67).

The quality that distinguishes the sportsman-salvor from other types is their relaxed, hey-I'm-on-vacation attitude. Because they typically do not spend much time or money on infrastructure (boats, excavation gear, remote sensing equipment, etc.), they often elude the attention of officials charged with protecting or regulating salvage. And although sportsmen-salvors invariably treat the subject as a hobby, the damage they do can be considerable. As someone once put it, "Little boys throw stones at frogs in sport, but the frogs die in earnest."

The second category of salvor found operating in the waters of the Turks and Caicos in the 1980s was the schemer-salvor. The best example of this category was TACMAR (Turks and Caicos Marine and Archaeological Recoveries, Ltd.). Having thoroughly impressed the British governor of the islands with tales of how he recovered a cargo of gold ingots from the HMS *Edinburgh* at the bottom of the Barents Sea, Keith Jessup, founder of the company, received *carte blanche* for 5 years to look for and salvage any and all shipwrecks in the territorial waters of the Turks and Caicos Islands. Everyone knew American treasure hunters were not to be trusted, but surely British salvors would be reliable. . . . And surely a man who salvaged a \$50-million treasure from a World War II cruiser sunk in 800 ft. of freezing, dark water could find treasure in the clear, warm waters of the Turks and Caicos. Five years later, when his contract ran out, Jessup pulled up stakes and left the islands a rich man. Fortunately, his profits were not derived from anything he discovered on the seabed but from shares he sold in the treasures he did not find—or, some say, even look for. This is the most salient feature of the

schemer-salvor: the sure knowledge that more money has been made through bogus investment schemes than was ever made through sale of treasure recovered from the sea.

And what results did TACMAR have to show after years of work and millions of dollars spent? They had about as much as Benchley and Tucker: two five-gallon buckets of broken glass and pottery, brass odds and ends, a tiny cannon, and a faded page-and-a-half photocopy of an artifact list.

Other operators were not so successful. A group calling itself Nomad Treasure Seekers showed up unannounced in 1981 with two boats painted to resemble U.S. Coast Guard vessels. Cloaked in the trappings of legitimacy supplied by a Ph.D.-bearing Classical archaeologist, Nomad managed to flimflam the government into letting them prospect for treasure. They ran amok for several months, trying to pry cannons off George's Cay (a national park), pillaging well-known wreck sites, and requiring the emergency evacuation of an embolized diver. Their vessels were finally boarded and searched, and a pathetic collection of broken pottery, lead pipes, and an anchor were seized by the police.

In many ways, dreamer-salvors are the most empathetic of the three categories. As much victims as perpetrators, they are in love with the romance, the intrigue, of shipwreck salvage and archaeology, but for some reason, they are incapable of pulling together all of the planning and resources necessary to undertake a serious marine operation. In 1982, I had the opportunity to observe this type of salvor at close range. Desperately in need of a seagoing vessel capable of spending weeks on Molasses Reef without returning to shore, I chartered *Dorothy B*, an old, 85-ft., wooden-hull patrol boat belonging to Caribbean Historical Research, a commercial treasure salvage company equally desperate to find work. *Dorothy B*'s crew of four, all French, was extremely competent, capable, and inventive. They had spent months lovingly modifying their vessel, equipping it with air compressors, cranes, dredge hoses, tank racks, special moorings, and

navigational equipment. They cut the sleeves out of their T-shirts and cultivated Hollywood tans. They were known in all the local bars for the marvelous stories they could tell. But they very seldom went to sea—until we got there. It took nearly 10 days to pry them away from the dock, but once we got to our site on Molasses Reef and began work, they were superb. My crew and theirs lived together on *Dorothy B* for more than 2 months. Eventually I realized that it did not matter to them what project they were working on. It was enough to be living the dream on a rough-and-ready salvage boat in the tropics and to be recognized as treasure hunters.

In 1985, while passing through Nassau on another boat, I saw *Dorothy B* for the last time, stripped and abandoned on a sandbar beneath the bridge to Paradise Island. Some time in the intervening 3 years, the dreamers woke up.

Another pair of dreamers caused me to travel to the Turks and Caicos for the first time in 1980. They called themselves Caribbean Ventures, but like many other dreamer-salvors, they never bothered to incorporate. Passing by the southern margin of the Caicos Bank while returning from Haiti in 1976 on their modified landing craft *Seeker*, the pair discovered a shipwreck site. They raised a few artifacts, returned to Miami, and began to dream. In their dream, the wreck they had discovered was none other than Columbus's *Pinta*, loaded with 2 tons of red pearls. The dream was attractive and easy to sell. On Columbus Day 1980, they announced their dream to the world in a story that made the front page of the *Miami Herald* (Toner 1980). Prominent historian Mendel Peterson lent his name to their cause. The *National Geographic* began to show interest.

Concerned that a potentially unique historical treasure might be in imminent danger, the governor of the Turks and Caicos fetched Dr. Colin Martin, an authority on the 1588 Spanish Armada shipwrecks, from the Scottish Institute of Maritime Studies and sent him to the site for verification. Dr. Martin vouched for the site's antiquity, pointed out the numerous difficulties in

assigning an identity to an unexcavated shipwreck, and suggested that the governor contact the Institute of Nautical Archaeology (INA) to provide an archaeologist to work with Caribbean Ventures.

About this time, Nomad Treasure Seekers swaggered onto the stage claiming, among other things, that it had inherited the site on Molasses Reef following the untimely and unfortunate incarceration of the Caribbean Ventures principals, who were charged with poaching on another treasure hunter's site in Florida. Sent by INA to see if there was any possibility of saving the site for archaeology, I ran headlong into both groups. Then things got a little confusing. To make a long story short, it is sufficient to condense some very interesting events into their ultimate result. The police ran Nomad out of the country, Caribbean Ventures simply never returned, and a fourth category of shipwreck user was introduced into the Turks and Caicos: realistic, legitimate maritime archaeologists.

Completing the Molasses Reef excavation required 14 weeks in 1982, 3 weeks in 1983, and another 8 weeks in 1985. As with all real archaeological projects, conservation and analysis of the finds consumed most of the next 8 years. Although this aspect of the work began at Texas A&M, the program was abruptly dropped after a few years. Undeterred, the graduate students conducting the research formed Ships of Discovery, a nonprofit archaeological institute, received custody of the artifact collection from the governor of the Turks and Caicos, and finished the project.

As the conservation and laboratory phase of the project drew to a close, the ultimate disposition of the artifact collection became an abiding concern. There was no museum or other institution in the islands capable of displaying, caring for, or even storing the artifacts. Would all of our hard work be for naught? What if we shipped the collection to the islands, only to have it end up rotting in the same forlorn warehouse as the Tucker Trove? Miraculously, I had the good fortune to meet people in the islands

who could make things happen. In the space of only 2 years between 1988 and 1990, the Turks and Caicos National Museum was created and mandated; conservation of the artifact collection was finished; exhibits were designed and constructed; and the entire collection was packed, shipped, and installed in one of the oldest and best-situated houses on Grand Turk, a house that had been converted into exhibit space.

From the day it opened, the museum was much more than anyone expected. The Molasses Reef wreck collection, the impetus for the creation of the museum, occupies the entire ground floor, while displays of the cultural and natural history of the islands occupy the second story. When Prince Phillip visited Grand Turk on official business in 1992, he was so enthralled by the museum that he stayed twice as long as his itinerary allowed, much to the consternation of his aids.

After the initial push in 1991 to open the museum, we realized that although the Guinep House was nearly perfect for exhibits, there was no place to work. The solution for this and other problems was to build a workshop in the lot behind the Guinep House. The building is designed for utility, not for exhibits. It is a place to clean, conserve, study, and store artifacts; a place to build new exhibits for the Guinep House as well as for satellite exhibits on other islands in the Turks and Caicos; a meeting place where talks can be given and ideas exchanged; a place where the history of the islands can be pieced together from the clues found in old maps and documents. The design called for a two-story building divided into six large, open rooms measuring about 30 x 17 ft. each, sitting atop a vast, 60,000-gal. cistern. On the ground floor are a shaded, cross-ventilated, open-air room for wet, messy work; a clean, air-conditioned laboratory for controlled, careful artifact conservation; and a climate-controlled artifact storage chamber. The second floor is occupied by a wood and metalworking shop for exhibit preparation, a lecture room, and a combination office and library. An enlarged, floored, well-

lighted, and insulated attic provides useful storage space. A stairway tower on the south side saves space inside the building. The entire structure is extra strong to protect the islands' heritage from hurricanes and is secured by an electronic alarm system.

Ours is to some extent a Field-of-Dreams approach to museums. "If you build it, they will come." In addition to providing a place to conserve artifacts, build exhibits, and carry out its other functions, the new building will also serve to demystify archaeology and history for the man on the streets. Our hope is that if enough local people see the work in progress throughout its many stages, and even have the opportunity to participate in that work, they will eventually come to realize that archaeologist is not just another word for treasure hunter, that we really do value even rusted nails and ballast stones. It is no wonder that, after the examples set by Teddy Tucker, Peter Benchley, Nomad Treasure Seekers, and all the others, native Turks Islanders are extremely skeptical of foreigners who do things out of sight, underwater, and far from land.

Despite the progress and the enviable infrastructure advances, the work has really just begun. The future holds many challenges. We can only hope that we are now adequately prepared to meet them. The primary threats to archaeological sites in the Turks and Caicos are commercial treasure salvage and development. The Executive Council is considering a proposal to permit the construction of a cruise ship port and support facilities on the uninhabited island of East Caicos. The proposal calls for the conversion of a large part of East Caicos to a "Fantasy Island" where cruise ship vacationers can frolic and unwind as far from reality as possible. Unfortunately, East Caicos is the location of important historic ruins, open-air Lucayan habitation sites as well as cave sites, and numerous shipwrecks, including one of the potentially most intriguing. This wreck was a ship that came to grief at Breezy Point, East Caicos, in 1841. Its

cargo was some 200 African slaves bound for Cuba. Most of the slaves and the ship's Spanish crew survived, as well as two strange wooden figurines at first thought to have been African but now known to have originated on Easter Island in the Pacific. The museum would like to re-locate the shipwreck and test the site, as well as follow up the few archival leads in the hope of discovering how artifacts from Easter Island came to be on the ship.

The latest twist in commercial shipwreck salvage is a proposal before the Executive Council in which native citizens are applying for permission to look for and salvage shipwreck sites in an area including almost half of the Caicos Bank. Their proposal is a duplicate of the TACMAR contract, which they see as a legal precedent. The government, having learned from its experience with TACMAR, would not consider granting such a contract to foreigners—but the fact that the applicants are natives of the Turks and Caicos makes it doubly difficult to refuse. "The government let the TACMAR contract. Will it not now do the same for its own citizens?" the applicants ask indignantly. The attorney general is desperately looking for a solution that will simultaneously satisfy the applicants, uphold the law, and discourage resource exploitation.

It is safe to say that other Caribbean nations are plagued by many, if not all, of the problems presently in evidence in the Turks and Caicos: how to educate and involve natives, how to attract legitimate archaeologists, how to overturn bad legal precedents, how to manage the impact of development, how to fund everything, and how to make it all work on a small island. The progress made in the Turks and Caicos away from exploitation and toward preservation has been about as fast as such progress can occur. Although events pertaining to underwater cultural resource management in the Turks and Caicos have undoubtedly been anomalous for a variety of reasons, there are important lessons to be applied in other countries. In most places, the

national museum is better off in private hands than under the control of the government. Find people in the private sector who are sympathetic to preservation and organize and motivate them to make it happen.

During the January 1983 Conference on Underwater Archaeology in Philadelphia, after spending almost 4 months in the Turks and Caicos, I delivered a paper titled "The Molasses Reef Wreck: A Study in the Essential Elements of Nautical Archaeology in the Caribbean" and concluded with the following paragraph:

Although we cannot yet assign an identity to the Molasses Reef Wreck, nor can we give it a date or claim that it is the oldest shipwreck found in the New World, there is a claim we can make that is just as significant. The government and people of the Turks and Caicos Islands now are aware that the shipwrecks in their territorial waters are just as important and in need of just as much conservation and regulation as their other marine resources: fisheries, lobster, and conch. They also are now aware that there is a viable alternative to simple treasure hunting and the sacrifice of public property to private gain. Thus *awareness* is the sixth—and at present the most—essential element of nautical archaeology in the Caribbean (Keith 1983:68).

Many times over the last 14 years, I thought I would have to eat those words but not anymore.

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Neocolonialism in Anguilla

An Immigrant's Tale

Anguilla is a small, sunny British colony in the northeast corner of the Caribbean. It is blessed with beautiful beaches, friendly people, an honest government, and a prison with more employees than inmates. A healthy, upmarket tourism sector provides a good measure of prosperity for 9,000 inhabitants.

Ten years ago, I was an arbitrator in Los Angeles with a strong interest in history. Seeking a saner, quieter life on an island in the tropics, I chose Anguilla as my adopted land.

The 1772 Wrecks

Anguilla is located on one side of the Anegada Passage, the preferred route for Spanish ships bound for the New World. In 1772, a *flota* of 16 ships sailed from Spain bound for Veracruz. The two large, armed escort vessels became separated from their flock in a storm. Following some navigational misadventures for which the captains were later court-martialed, both ships ended up on the rocks on the part of Anguilla facing Spain.

These ships were the 70-gun man-of-war *El Buen Consejo* and the *Jesús, María y José*, a 40-gun armed merchant vessel. At 990 and 673 tons respectively, they carried nearly a thousand people, including 52 Franciscans who could read and write.

And write they did. Between them and an army of Spanish clerks, scribes, officials, and bureaucrats, they created a thousand documents concerning the ships and their equipment, maintenance, supplies, cargo, crew, and passengers and the events that have caused their memory to live on. Today, those documents reside in the Archivo General de Indias in Seville.

A Splendid Drama

In 1772, Anguilla was a dirt-poor, neglected British colonial backwater where some 2,300 people were struggling to survive. Suddenly and without warning, a thousand stressed-out Spaniards arrived for breakfast, carrying with them no shelter and little food, but tons of books, paper, clothing, wax, iron bars, wire thread, wine, aguardiente, 13,095 lbs. of cinnamon, and more religious medallions than would ever be seen again on Anguilla.

This story—and that of the salvage attempts, the tensions between Spaniards and Anguillians, the hurricane 52 days later that destroyed the wrecked ships, the rescue of the stranded Spaniards, and the court-martial of the accused—is a splendid drama but not the subject of the present discourse.

Virgin Territory

When I first arrived in Anguilla nearly 10 years ago, I learned there were some two dozen pre-20th-century shipwreck sites surrounding the island. No underwater archaeology had ever been done there. I knew only that the greatest archaeologists of all time were Howard Carter, Mel Fisher, and Harrison Ford and that *National Geographic* was an ethical, learned, and respected scientific journal.

Cleverly using this vast technical knowledge, I was elected to the board of the Anguilla Archaeological and Historical Society. The archaeology referred to in this name is Amerindian, but underwater cultural resources have become a recent interest.

I want to make it clear at this point that although I sit on various boards and committees relating to Anguilla's history, archaeology, and national museum, I do not speak for these groups or for our government or for anyone else. There are those in Anguilla whose views differ widely from my own and who would be pleased to see the back side of me. I am simply one

man, doing what I can to preserve the cultural resources of my island for those who come after us.

Later, I will discuss the Society for Historical Archaeology and its policies. I am an SHA member, but I am not an archaeologist, so I am not sure whether SHA is "you" or "we." Out of respect for the professional qualifications that most of you have but I lack, I have chosen the "you" rather than the "we." My intent is not to be unfriendly.

Most of Anguilla's waters remain virgin territory for archaeology. Anyone wishing to contribute to our knowledge of Anguilla's cultural resources will find a warm and friendly welcome there.

Looting and Plundering

In the summer of 1994, reports circulated that the 1772 wreck sites were being looted. It seemed to me that some of these artifacts should be in our national museum. Others, I thought at the time, could perhaps be sold to raise the funds needed to finish building this same museum. I did not know that there were ethical problems involved or that the contextual surroundings of these artifacts were of any interest to anyone. I was not looking to make anything for myself. I did not have a job and was not looking for one. Archaeology was a delightful concept before I actually starting doing anything about it.

The Peabody Essex Museum

Knowing no one in the field, I wrote to the Peabody Essex Museum in Salem, Massachusetts, because I had heard it was a professional organization. I soon received a kind letter from Dr. Daniel Finamore, the maritime curator, informing me that many professional organizations, including the Society for Historical Archaeology, had adopted policies regarding the sale of artifacts. He provided a great deal of guidance on the proper way forward.

The Historic Wrecks Advisory Committee

Several groups made various inquiries, claims, and applications to the government of Anguilla for salvage rights to the 1772 wrecks. Amid accusations by the British governor that the Anguillian chief minister and parliamentary secretary were attempting to enrich themselves personally by delaying action on the proposals, government appointed a citizens' committee, the Historic Wrecks Advisory Committee, to review various alternatives and make recommendations to the chief minister.

Of the five or more groups that had made inquiry, three submitted written proposals, some of them quite bulky.

Their bulk seemed to me to have the primary purpose of concealing their essence: that these folks wanted to come to Anguilla, extract what is presently the property of the people of Anguilla, haul away yet another part of the wealth of the Indies, and sell it, saying they needed the money to reimburse themselves for the enormous amount they had paid to have it extracted. At best, I thought, this would leave us a few trinkets for our dusty museum, a hole in the ocean floor, and yet another lost opportunity for archaeologists, historians, and the long-suffering people of the Caribbean who, like cattle, have sometimes not been consulted about their fate.

Neocolonialism

For 500 years, foreigners have been coming to the Caribbean seeking the wealth of the Indies. If they were able to find it, they simply took it home with them. If anyone objected, they were eliminated. The godless and ill-clothed Amerindians, who naively thought these islands were theirs, were simply exterminated. To replace them in the fields and mines to extract the wealth of the Indies, Africans were imported much as one might move cattle from one ranch to another. These Africans were considered to have rights approximating those of unowned

cattle and would, it was believed, morally benefit from being given some direction and purpose in their lives.

In the old days, such activity was called colonialism. While such exploitation is no longer as blatant or widespread as it was in the past nor held up as commendable by both church and state, it can be still be seen today on our island, primarily in the communications sector and, to a lesser extent, at some hotels. Vestiges are also visible in the attitudes of a small minority of uncaring foreigners. Whether one group is actually exploiting another economically or merely viewing them as lesser beings, in the late 20th century, such conduct is called neocolonialism.

Mixed Reviews

At the first meeting of the Historic Wrecks Advisory Committee, I pointed out that some applicants had present or prior affiliations with people from whom professional archaeologists often attempt to distance themselves. Another member of the committee stated that in his view "all such persons seeking salvage rights were only looking to enrich themselves at the expense of historical patrimony." Future hearings were scheduled for each applicant.

Adventure, Inc.

At the next committee meeting, we were given a presentation by a group from Holland and Canada styling themselves Adventure, Inc. They proposed raising U.S. \$1.3–1.5 million for a project that included only \$22,000 for artifact conservation.

They listed among their professional advisors the Museo Marítimo in Seville and provided the dates of their 3-day meeting with the museum's management and curators. Perhaps by mistake, they also gave us copies of an internal memo stating that this museum would be closed on the dates of the alleged 3-day meeting and apparently for the entire period of their stay in Seville.

Dr. Thijs J. Maarleveld

Adventure, Inc. said they had "extremely strong technical and academic support" and listed among their advisors not only the closed historic museum but also Dr. Thijs J. Maarleveld, Head of the Department of Underwater Archaeology of the Netherlands State Service for Archaeological Investigations. The committee was told that Maarleveld was their consulting archaeologist.

I read them a list of professional organizations prohibiting their members from working on projects resulting in random dispersal of artifacts and asked if Maarleveld had any problem with that. They responded that Maarleveld's only condition to his participation (and presumably that of the Netherlands as well) was that the recovery must be legal in Anguilla and elsewhere. I asked them if Maarleveld was aware of their intention to sell artifacts on the open market. They responded that he had read their proposal and had offered no objection.

Because of Maarleveld's impressive credentials, the meeting went rather well for the applicant. I was so impressed, in fact, that I inquired myself and was informed that Maarleveld was not working with any treasure hunting group, either as a consultant or an archaeologist. Maarleveld had allegedly been sent a proposal that had not indicated that artifacts would be sold.

Anguilla Maritime Research, Ltd.

The next meeting of the committee was called to hear a presentation from an American financed group called Anguilla Maritime Research, Ltd. (AMR), which had already financed some impressive work at the archives in Seville relating to the 1772 wrecks.

AMR complained to the committee that the Adventure, Inc. people had attempted to obtain copies of the work financed by AMR by offering a bribe to one of their researchers. AMR also alleged that researchers for Adventure, Inc. had falsely presented themselves to the Archivo

General de Indias by claiming to represent the government of Anguilla.

An Ethical Middle Ground?

AMR proposed what they called a new departure in archaeology: an ethical middle ground between the villainous treasure hunter and the ineffective professional archaeologist, reduced by his own crippling, self-imposed regulations to giving classroom lectures on underwater archaeology to the next generation of underwater archaeologists, trapped forever in their classrooms, free only to teach, write, and stare at their computer screens while the world's shipwrecks are looted by treasure hunters, adventurers, and pirates dressed as archaeologists. AMR offered to do wonderful things for us, wonderful things that included selling 80 percent of the recovered artifacts and keeping most of the money. This arrangement is called private enterprise.

The Third Applicant

The committee met again to hear the third applicant, led by an American with a vacation house in Anguilla. He told us he had discovered the *Buen Consejo* site in 1991 along with an Anguillian fisherman with whom he had agreed to share the proceeds. He seemed visibly shaken when asked if he was aware that this partner was also president of a competing applicant company.

A presentation was made in support of this applicant by an American lawyer who specializes in representing "those who seek to recover historic shipwrecks." He mentioned with apparent pride the *Atocha*, Mel Fisher, the *Monitor*, the *Andrea Doria*, Duncan Mathewson, Teddy Tucker, and the *Central America*. In each little story, he referred to what "we" did, although it was entirely unclear who "we" were, whether "we" were the same group throughout, or whether "we" included his present client.

I abandoned my questioning after the lawyer admitted that his part in the *Atocha* adventure was as a summer law clerk for Mel Fisher's lawyer. The only archaeologist he mentioned was

Teddy Tucker, who, he was forced to admit, "lacked a formal degree."

A Recommendation

All applicants assured the committee that funding for an academically oriented group simply did not exist.

With no reasonable alternative in sight and feeling an obligation to our government to take action instead of offering excuses, with the vandal hordes about to carry away what little was left and having no effective way to secure the site, the committee recommended that AMR was the only logical choice. We suggested that we, rather than the attorney general's office, be assigned the task of negotiating the proposed agreement. These recommendations were approved by the Executive Council.

Dr. Margaret Leshikar-Denton

Late that month, a committee meeting was called to consider a letter received from Dr. Margaret Leshikar-Denton of the Advisory Council on Underwater Archaeology (ACUA). She had received a letter from Dr. Maarleveld, who was concerned about the activities of Dutch sport divers in the British West Indies.

Dr. Leshikar-Denton provided the committee with useful and interesting information about the protection of shipwreck resources. When I sought further details from her, she invited me to attend the 1996 Conference on Historical and Underwater Archaeology in Cincinnati, where I could meet many of the people in underwater archaeology and perhaps identify a sponsor for an ethical project in Anguilla.

In Cincinnati, I was an invited guest at an ACUA board meeting. These were the people we had been warned about, the people we had been told were a mere handful of ivory-tower lunatic-fringe radical-extremists completely out-of-touch with their own colleagues and the economic reality of field work, the people who were only interested in frustrating the advancement of private enterprise and gratifying their own egos. I wondered for a moment if I had

gotten off the plane on the wrong planet. They seemed to be a whole lot like regular people.

My Report

Returning from Cincinnati, I reported to the committee that East Carolina University (ECU) had expressed interest in establishing a long-term field school program to locate, survey, and document Anguilla's underwater cultural resources.

I again tried to convince the committee that if our national museum hoped to be a member of museum organizations, it would be prohibited from displaying artifacts from commercially exploited sites. The committee chose to believe otherwise since the British Museum and other fine institutions are "full of stolen stuff."

A new letter from Dr. Leshikar-Denton stated that Anguilla could disregard the recommendations of international museum organizations but in so doing would lose any chance of funding assistance from international foundations and granting organizations. This information received considerable attention from the committee and was a turning point in strengthening our resolve.

East Carolina University and the Maritime Archaeological and Historical Society

Working with the Maritime Archaeological and Historical Society (MAHS), East Carolina University (ECU) sent a written expression of interest in working in Anguilla's waters. The committee responded with enthusiastic encouragement and offers of in-kind contributions.

Leaders of both groups visited Anguilla, and some 15 people from both organizations returned in September 1996. Under the direction of ECU's Dr. Bradley A. Rodgers, the group produced a detailed map and site analysis for the government. The map will provide an informed basis for authorizing and monitoring all future work on the 1772 wrecks.

ECU gave the committee valuable suggestions on the proposed agreement with AMR. These included the requirement that the work would comply with the code of ethics and standards of research of the Society of Professional Archae-

ologists. The ethics, of course, prohibit the trade of underwater cultural heritage as items of commercial value.

These and many other suggestions were unanimously adopted by the committee, and ECU's contribution provided yet another vital turning point in the work of the committee.

Finally, less than 2 months ago, we learned that AMR had abandoned all claim to artifacts and is hoping to finance the project through selling intellectual rights and by operating an underwater marine park on the *Buen Consejo* site. Negotiations between AMR and the committee have gone on for nearly 2 years and continue to this day.

The National Geographic Society

These long and difficult negotiations have taken place in a climate in which it is possible for treasure hunters, adventurers, and con men to bewitch small island governments with what they claim is "standard practice" throughout the known universe: awarding treasure hunting contracts that are in many ways identical to offshore oil drilling ventures, with the foreign contractors getting the bulk of the resulting revenue.

In my opinion, the single most important factor in creating this climate of commercialism has been the influence of the National Geographic Society and its traditional endorsement and glorification of treasure hunting for profit.

Only the Paranoid Survive

In November of 1996, proponents of commercial trade in Anguilla's artifacts used a recent *National Geographic* article on treasure hunting on the Silver Banks north of the Dominican Republic as evidence that cooperation between long-established, ethical, national museums and commercially motivated archaeologists was "standard practice" throughout the world.

The facts are that neither museums nor archaeologists were mentioned at all in this article and that in recent months the government of the Dominican Republic has reversed its policy regarding treasure hunters. Such details went unno-

ticed by influential leaders of our archaeological society, our National Trust, and our national museum, who now treat me as though I had joined some lunatic religious cult.

I cannot effectively stand up alone, with less professional standing than any first-year archaeology student, and tell well-meaning folks in Anguilla that the widely respected *National Geographic* is wrong; the legendary Mel Fisher is wrong; Adventure, Inc. and many other adventurers are wrong; the pure and virtuous Indiana Jones is wrong; but I am right. I need your help.

Ivory Hunters and Genocide

In the old days, *National Geographic* glorified ivory hunters who took what they wanted and left piles of toothless dead elephants behind them. They stopped promoting this international theft when enough people found it unacceptable. And we were running out of elephants. But today, when *National Geographic* gets near water, it cannot tell the difference between treasure hunting and archaeology.

In places like Guatemala that have a dominant culture of genocide, anthropologists have had to take sides because their field of study was being eliminated. Do we have a similar situation in underwater archaeology?

Have archaeologists, anthropologists, museum curators, and other right-thinking people combined forces to mount an effective public campaign to counter these arguments or even tell laypersons that a controversy exists?

When professional societies do nothing effective, the enormously influential *National Geographic* is allowed to create the climate that makes it possible for the greedy to convince small island governments that it is I and others like me who are the lunatic fringe of extremists.

Selling Magazines

I suppose it is the job of *National Geographic* to sell magazines by running heroic tales of lost pirate treasure instead of boring stories about baby birds. If there is no public outcry, and they are selling those magazines, why should they change their policy?

The sad thing here is not what *National Geographic* has done, but that the professional societies, with their enormous moral authority, have failed to raise any significant public objection.

An Appeal

Because I believe it my obligation to serve those who come after us in Anguilla, I have worked hard, taken risks, made enemies, received a threat to my life, and even braved the weather in the frozen north to address the Conference on Historic and Underwater Archaeology.

To borrow the words spoken recently to the U.S. House of Representatives by the Speaker of the House, to the degree I am being too brash, too self-confident, or too pushy, I apologize. It is my intention to do everything I can to work with every member of the Society for Historical Archaeology.

I became a member of the SHA because I believed the Society was doing something important. I am more than ever convinced of this. It is important to me that the SHA is as effective as possible.

Most of the public believes that cultural resources belong to whoever can get them first. If SHA and ACUA fail to lead an effective education campaign to change this perception, who will do it?

If it is not done now, when will it be done?

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PILAR LUNA ERREGUERENA

Stepping Stones of Mexican Underwater Archaeology

Mexican underwater archaeology is barely 17 years old, young indeed, but with an intense, difficult, and very enriching history. Since 1980, year of the official birth of the Departamento de Arqueología Subacuática (Department of Underwater Archaeology) within the Instituto Nacional de Antropología e Historia (National Institute of Anthropology and History), we have undertaken projects in both interior and marine waters, investigated reports of sites, trained young archaeologists and conservators, stopped foreign and Mexican treasure hunters, and above all, raised a certain national consciousness regarding the immense value of our submerged cultural patrimony.

As recounted in the paper entitled "Underwater Archaeology in Mexico," presented 8 years ago in Baltimore, antecedents of Mexican underwater archaeology include artifact recovery from various cenotes, springs, and lagoons, primarily in Yucatan and Central Mexico, as well as from shipwrecks in the Caribbean and the Gulf of Mexico. The collections were made between the end of the 19th century and the late 1960s by divers. In only two cases, a couple of land archaeologists were involved: the Sacred Cenote of Chichen-Itza and the Blue Cenote of Chinkultic, in the southern part of Mexico.

During the 1970s, a group of students in the Escuela Nacional de Antropología e Historia (National School of Anthropology and History), including this author, became interested in learning how to dive in order to do underwater archaeology. While we certainly learned how to dive, it was 5 years before we found out what this discipline was all about. In 1978, we organized the first course on underwater archaeology. Several Mexican professors specializing in areas related to this discipline participated in the course. Previously none was aware that their specialties could be valuable in underwater archaeological research; in fact, they knew nothing

about the existence of underwater archaeology. At the beginning of 1979, George Bass and Donald Keith spent a month in Mexico City opening the gates for us to this new and amazing world. I have always believed that Dr. Bass perceived the anguish contained in the letter we sent him asking for help.

The Real Treasure Is to Work as a Team

Ever since I was young, I have been convinced that if people work as a team and bring their efforts together, they will achieve the best results. Time has proven this to be the case. Through the years, we have learned more than underwater archaeology. Perhaps the most enriching discovery has been the opportunity to work as a team to reach our goals through the help and support of individuals and institutions. Each has been a valuable stepping stone in our road.

Even before the creation of the Departamento de Arqueología Subacuática, we faced our first challenge to survey a site in the Gulf of Mexico discovered by two North American sport divers. We knocked at several doors without knowing if they would be opened for us. For example, we asked the Mexican navy for a ship capable of housing nine Mexicans, three members from the Institute of Nautical Archaeology, and the two discoverers. As a result, a mine sweeper was our home during the 1979 season and for three other trips to the Cayo Nuevo reef in the Gulf of Mexico. Since then, each time that we have asked for help, the Mexican navy has responded not only with ships but also with an aircraft, a helicopter, and land vehicles.

Besides the navy's help, in 1980, we received support from PEMEX, the Mexican oil company, which provided a ship with a decompression chamber on board and a group of commercial divers to help in the recovery of the oldest bronze cannon of its type ever found in the Western Hemisphere.

Also, Captain Octavio Díaz González from the Secretaría de Educación Pública (Ministry of Public Education) collaborated by supplying specialized divers, including two Poles, and by helping us to bring in diving equipment from the

United States. Through the years, Captain Díaz González became an important participant in the defense of Mexican submerged cultural patrimony against treasure hunters.

Another institution that gave us its unconditional help was the Instituto de Ciencias del Mar y Limnología (Institute of Marine Sciences and Limnology) from the Universidad Nacional Autónoma de México (UNAM). In 1990, this institute together with the Departamento de Arqueología Subacuática and Ships of Exploration and Discovery Research undertook a joint project on a 16th-century shipwreck at Bahía de Mujeres in the Mexican Caribbean.

The Bahía de Mujeres wreck was discovered in the late 1950s. From then until the beginning of the 1960s, several pieces of artillery were recovered by divers mainly from CEDAM, a sport diving club. Unfortunately, none of these artifacts ever received conservation treatment. Some were taken abroad, others are lost, and the remainder show advanced states of deterioration. The discoverers of the site wrongly thought that the shipwreck was *La Nicolasa*, one of the main ships of Francisco de Montejo's fleet.

Years later, at the beginning of the 1980s, Donald Keith and Roger Smith, both interested in ships of exploration and discovery, learned about the Bahía de Mujeres wreck. Subsequently in 1983 and 1984, the Departamento de Arqueología Subacuática, the Mexican navy, and the Institute of Nautical Archaeology made two survey trips to re-locate the site.

In 1990, the Instituto Nacional de Antropología e Historia together with UNAM and Ships of Discovery joined efforts to partially excavate this site, which is located in a popular reef near Cancun. The role of biologists from UNAM was crucial. Once the archaeologists determined the area to be excavated, a group of biologists registered the existing flora and fauna and removed the living corals from that zone. After the archaeologists finished their work, both groups covered the site with the same dead coral that was removed while specialized biologists replanted the living corals. The site was constantly monitored by biologists. A year later, they reported that there were practically no vis-

ible traces of the digging and that the area of the reef affected by the archaeological project was completely reestablished.

In addition to the help received from institutions in Mexico, there are individuals whose participation in different aspects and levels of projects has contributed to the road walked day by day. Time does not allow to name them here, but we recognize their presence and their importance and remain grateful to them.

Mexican underwater archaeology would not be where it is now without the committed assistance of the Institute of Nautical Archaeology and the Ships of Exploration and Discovery Research group. Special mention of specific people who worked shoulder-to-shoulder with us includes, in the order they came to Mexico: George F. Bass, Donald H. Keith, Roger C. Smith, Donny L. Hamilton, Joe J. Simmons, Denise C. Lakey, Gordon Watts, Margaret E. Leshikar, Dennis Denton, Mark D. Myers, and Toni L. Carrell.

Other assistance came from the Submerged Cultural Resource Unit of the United States National Park Service which joined efforts with Mexican authorities and specialists to re-locate and document the USS *Somers* sunk near the coast of Veracruz. For our project on prehispanic navigational aids along the coast of Quintana Roo, we received financial support from the National Geographic Society. At the same time, many people have assisted and worked with us moved either by their love for the ocean and its secrets or for the sake of helping good causes. As mentioned earlier, each of these individuals and institutions has been a most valuable stepping stone in our path.

A Significant Leap in Mexican Underwater Archaeology

As seamen know, there are moments of calm and moments of intense activity when significant progress is made. The same is true for personal and professional processes. In recent years, Mexican underwater archaeology remained at an impasse. Then in 1994, an awakening occurred.

That year, the first *diplomado* (course of study) on underwater archaeology was given. It

was a master's level course in which 24 Mexican, 4 North American, and 2 Canadian professors were involved. Twenty students, mainly with backgrounds in archaeology and conservation, successfully completed the 6-month course. Academic lessons were given in a classroom, diving and archaeological techniques were taught in swimming pools, and a final field project was undertaken in Isla Mujeres, Quintana Roo. There, interaction with local fishermen, divers, and various members of the community resulted in interesting recorded interviews, reports of shipwreck locations, and valuable information and contacts for future projects.

Among other activities, the students recorded and mapped a shipwreck located between Isla Mujeres and Isla Contoy. They also worked at the local park and museum known as El Garrafón, cleaning, classifying, and drawing artifacts recovered from the sea through the years by locals. This park includes a submerged attraction site consisting of four cannons and one anchor rescued from nearby shipwrecks and placed in shallow waters near the beach. Using dredges, the students removed the sand that covered these cannons, and practicing with lifting balloons, they relocated the cannons to a better place a few meters away.

The 1631 New Spain Fleet Project

After the *diplomado* concluded, the big challenge was to find a way for these students to do underwater archaeology. The solution was especially difficult to achieve in the middle of the severe social, economic, and political crisis that Mexico was enduring.

Without a doubt, miracles exist. The most ambitious underwater archaeological project in Mexican history was born in 1995, sponsored by a trust fund created specifically to assist in the research of shipwrecks in Mexican waters. Through this fund, we hired five students who had graduated from the *diplomado*. Another six are also collaborating indirectly. Initially, this project was planned to study only *Nuestra Señora del Juncal*, the shipwreck most coveted by treasure hunters over the last 18 years. From

the beginning, we knew that *Nuestra Señora del Juncal* was part of an important fleet. As archival research in Mexico and Spain began to bear its first fruits, it became evident that the project should include investigation of the whole 1631 New Spain Fleet, sunk in the Gulf of Mexico.

At this stage of the project, we have combined archival and ethnographic research. This combination has been of great value for our study. Through the incorporation of these two avenues, we reconstructed the route followed by Melchor Candano, accountant of king Felipe IV, who was commissioned in 1632 to find out what had happened to the treasures lost with the fleet. Project researcher Jorge Manuel Herrera has followed Melchor Candano's steps to places in the Yucatan peninsula that the royal accountant visited 3½ centuries ago.

The 1631 New Spain Fleet is a long-term research project with many goals, including development of an inventory of submerged cultural resources in the Gulf of Mexico and creation of a maritime museum for our country. The first field season is planned for the spring of 1997 with the collaboration of the National Park Service Submerged Cultural Resource Unit and Ships of Discovery Research.

Mexican Underwater Archaeology's Promising Future

At the time that the New Spain Fleet project was being initiated, the Departamento de Arqueología Subacuática was promoted to a *subdirección*. The promotion represents a recognition of the importance of underwater archaeology and is the result of two decades of struggle.

The *diplomado* was such a success that a second one is being prepared to be given in the summer of 1997 in Cozumel, Quintana Roo. In addition to Mexican participants, an invitation will be extended to students from the Caribbean region as well as Central and South America. Underwater archaeology is starting to emerge in other Latin American countries. Over the last two years, ties have strengthened with such nations as Uruguay, Argentina, Honduras, and Guatemala, where a national consciousness is being

gradually raised. A regional network is being created, little by little, but in a consistent way.

In spite of the fact that now we have more human and material resources, we still have enormous problems to solve and challenges to face. Thanks to the level of consciousness raised over the years, academic and official support have increased. However, we still need to work harder to train young professionals, to reinforce the existing laws, to enrich mechanisms of interaction with authorities, institutions, and individuals connected to the submerged cultural patrimony, to promote interdisciplinary research, and to raise a higher degree of national awareness.

So far, the balance is positive. There are many more stepping stones on the road to our goals of successful management of the Mexican sub-

merged cultural heritage. But as the great Spanish poet Antonio Machado said, "There is no road. The road is made while you walk."

ACKNOWLEDGMENTS

Besides the acknowledgments expressed above, the author would particularly like to thank the Instituto Nacional de Antropología e Historia (INAH) for its continuous support and the Fideicomiso para el Rescate de Pecios for its interest and sponsorship of the current 1631 New Spain Fleet Project.

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Rescuing the *Monitor*: Stabilization and Recovery Efforts at the *Monitor* National Marine Sanctuary

Introduction

The Civil War ironclad warship USS *Monitor* was quite unlike any other vessel afloat. Launched on 30 January 1862, the *Monitor* had more the appearance of a modern submarine than a contemporary warship. Its hull was almost completely submerged—only 13 in. (33 cm) of freeboard when in battle trim—and its only superstructure was an armored gun turret amidships and a small pilot house forward. *Monitor*'s framing and lower hull were constructed of iron;

however, it was not entirely an iron ship. Its main deck was composed of oak beams planked over with pine and covered by a protective layer of iron plate. Likewise, the armor belt that encircled its upper hull consisted of a thick band of oak and pine plated over with five layers of iron. Instead of a conventional broadside of cannon, *Monitor*'s armament consisted of only two 11-in. (28 cm) Dahlgren smoothbore cannon, mounted side-by-side in a unique revolving turret.

The *Monitor*'s radical design was put to the test on 9 March 1862 when it fought CSS *Virginia* (ex-USS *Merrimack*) to a draw at Hampton Roads, Virginia, in one of the most celebrated naval battles in history. Although quite different in appearance, the two ironclads shared several innovative traits: both were protected by wrought-iron armor and partially submerged hulls; both were powered by steam alone, with



FIGURE 1. The *Monitor* sinking off Cape Hatteras, North Carolina, on 31 December 1862 [Harper's Weekly 1863, 7(317):60-61].

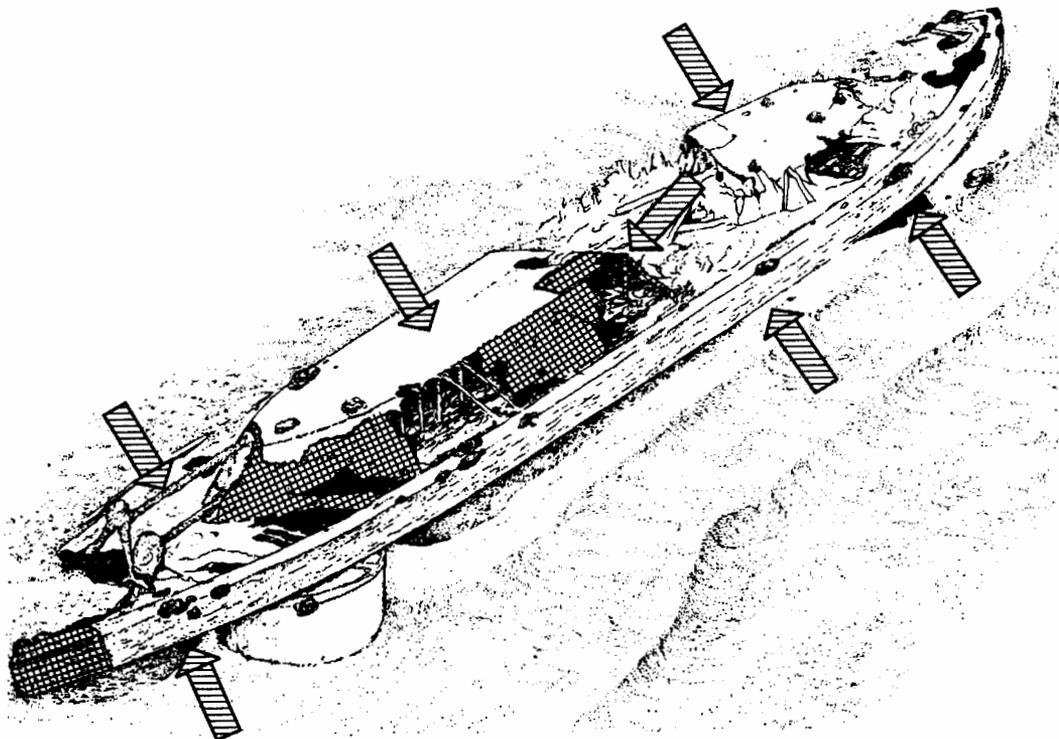


FIGURE 2. Isometric drawing of the *Monitor* as it lies on the ocean floor, inverted and resting on its turret (NOAA).

no masts or sails; both were driven by screw propellers; and both were designed to fight effectively with relatively few cannon. Their confrontation at Hampton Roads was the first instance in which these new designs were tested against each other in combat. The result, acknowledged around the world, was the rapid abandonment of conventional wooden, sail-powered warships and an escalation of naval weaponry and armor.

In spite of its near invulnerability to cannon fire, however, the *Monitor* was not designed for open water. It nearly foundered on its way to Hampton Roads on 6 March. Then on New Year's Eve 1862, while being towed south along the coast, the *Monitor* took on water and sank in a severe storm off Cape Hatteras, North Carolina, with a loss of 16 lives (Figure 1).

Protection and Management

The *Monitor* was discovered in August 1973 by a scientific team from the Duke University Marine Laboratory in Beaufort, North Carolina. The wreck lies in 230 ft. (71 m) of water, approximately 16 nautical mi. SSE of Cape Hatteras Lighthouse (Watts 1975; Miller 1978: 57–84, 91–93). Immediately following the *Monitor's* discovery, numerous organizations and individuals began seeking the means for protecting the historic ship, a task made difficult by the fact that *Monitor* lay beyond the territorial limits of the U.S., rendering most federal antiquities legislation ineffective. The solution proved to be as innovative as the ironclad itself: it was discovered that a new Federal law, the Marine Protection, Research and Sanctuaries Act of 1972,

could protect the *Monitor's* remains. Therefore on 30 January 1975, the *Monitor* became the first National Marine Sanctuary, under the protection and management of the National Oceanic and Atmospheric Administration (NOAA). This role is carried out by NOAA's Sanctuaries and Reserves Division (SRD), which manages 12 National Marine Sanctuaries and 22 National Estuarine Research Reserves throughout the continental U.S., Hawaii, and American Samoa. NOAA (1982) published a management plan for the *Monitor* and is currently in the process of revising the plan to reflect the results of recent scientific research. The *Monitor* has also been listed on the National Register of Historic Places and designated a National Historic Landmark (Delgado 1988).

The *Monitor's* inaccessibility is a major factor influencing both management and research. It lies on a flat, featureless, sandy bottom; the 230-ft. (71-m) water depth places it out of the reach of most scuba divers. The *Monitor* rolled over as it sank causing its turret to pull free and fall to the bottom, upside down. The hull then settled to the bottom where it landed on the turret. The inverted hull now rests partially buried in sediment with the stern port quarter supported above the bottom by the displaced turret (Figure 2). The lower hull, which is now the highest part of the wreck, has collapsed forward of the midship bulkhead, and the stern armor belt and associated structure is badly deteriorated. The position of the turret under the port quarter elevates the stern and port side producing a list to starboard and creating severe stresses on the hull.

The *Monitor* suffers from extensive deterioration and structural damage as a result of three factors: damage that occurred at the time of sinking, deterioration caused by more than a century of exposure to a dynamic seawater environment, and damage resulting from human activities. The wreck lies near the confluence of two major ocean currents: the cold, southerly flowing Labrador Current and the warm Gulf Stream, which follows the coast northward until it reaches the coastal projection known as Cape Hatteras, where it begins to turn eastward. These currents battle for dominance in the vicinity of

the *Monitor* creating confusing and often violent seas and currents that can create tremendous stresses on the *Monitor's* hull and carry away loose objects. Several researchers have hypothesized that the *Monitor* was inadvertently depth-charged during World War II resulting in visible damage to the lower hull and, possibly, to the stern armor belt. In addition, there is evidence that the wreck has been damaged by illegal anchoring and fishing activities. A private fishing vessel anchored illegally on the *Monitor* in 1991 apparently initiating a chain reaction of deterioration and collapse that is still underway.

Scientific Investigations

Since its discovery in 1973, the *Monitor* has been the object of numerous scientific expeditions. NOAA has gathered a considerable amount of data at the sanctuary through the application of a wide range of ocean technologies (Watts 1975; Arnold et al. 1991). Observations over the past five years have revealed a very serious increase in the rate of hull deterioration. When NOAA began revising the *Monitor* sanctuary management plan in 1992, it was recognized that additional site data were needed in order for effective long-range management decisions to be made. As a result, NOAA planned a series of scientific expeditions to the sanctuary.

The 1993 MARSS Expedition

During July and August 1993, NOAA conducted the *Monitor* Archaeological Research and Structural Survey (MARSS) expedition. The principal goals were mapping, videotaping, mooring deployment, and test excavations. Several of the planned activities required the use of divers. Because of the adverse environmental conditions at the sanctuary, NOAA conducted extensive advance planning, equipment procurement, and specialized training. For primary support, NOAA chartered the research vessel *Edwin Link* from the Harbor Branch Oceanographic Institution (HBOI), Fort Pierce, Florida. HBOI participated in several past *Monitor* expeditions and thus has developed a high degree of familiarity with the

wreck site and operating conditions at the sanctuary.

The depth and frequently strong currents made it essential to develop a dive plan which would take into account the often difficult seas and currents, ensure the safety of the divers, and permit the accomplishment of project goals. Divers breathed a mixture of oxygen, nitrogen, and helium, generally referred to as tri-mix. Because the proportion of gases (18% oxygen/32% nitrogen/50% helium) was optimized for the depth and desired dive times at the *Monitor*, this mixture was given the designation "*Monitor* tri-mix." All divers participated in a week of dive training before the mission. In addition to bell dives, a number of dive activities were planned for HBOI's manned submersible *Johnson-Sea-Link II (J-S-L II)*. *J-S-L II* can accommodate a pilot and observer in a forward compartment and two observers in an aft compartment. The submersible operates independently of the surface ship and can record high-resolution video and conduct a variety of tasks using an articulated mechanical arm.

The expedition was conducted from 26 July through 11 August 1993. Dives were conducted from a NOAA open bell lowered from the deck of the *Edwin Link*. This procedure required the *Link* to remain stationary over the site. The installation of a suitable temporary four-point mooring—a major effort in itself—was accomplished by the U.S. Navy submarine rescue vessel USS *Ortolan (ASR-22)*. Once the R/V *Edwin Link* was secured in the mooring, the lines were adjusted so that the bell would descend precisely to a predetermined position near the *Monitor's* hull.

Extremely adverse weather conditions severely hampered operations resulting in the completion of only nine submersible dives and three bell dives. In spite of these problems, several major objectives were completed (NOAA 1993). A major accomplishment of the MARSS expedition was the placement of a 1,000-lb. concrete mooring block for use on future expeditions. This task was very important since the mooring was badly needed and since it could not be deployed without the specialized equipment available dur-

ing MARSS. Placement of the mooring block in the correct location without damaging the *Monitor* required the precise positioning control and heavy lifting capability of the research vessel as well as observation reports from the submersible. The mooring was designed to provide a fixed location for diver descent and a stationary ascent line for in-water decompression.

Another major objective was to study the turret more closely. Although there have been numerous suggestions for raising, conserving, and exhibiting the turret, it was recognized that any such planning would have to be preceded by surveys to determine such factors as whether the cannon are still inside and whether the turret is filled with silt. It is assumed that the *Monitor's* two 11-in. Dahlgrens and their carriages are still inside the turret. However, the gun ports are closed and the upper edge of the turret (which is now the lower end since the turret is inverted) is covered by a layer of sand and silt. A small test excavation was dug in the base of the turret to determine whether or not the pine deck is still intact. The test, conducted under the supervision of an archaeologist in the submersible's pilot sphere, verified that the floor, or deck, of the turret has disintegrated and that the turret is completely filled with silt and debris. This information was essential for assessing the condition of the turret and estimating the feasibility of future recovery, conservation, and display of this famous iron cylinder. A second test excavation was conducted outside the turret by *J-S-L II* to examine the exterior wall of the turret and to determine the configuration of the top (now the bottom) of the turret. The excavation did not penetrate all the way to the rim but did verify that the buried portion of the turret appears to be in good condition.

Another primary goal of the MARSS expedition was to continue long-term mapping efforts designed to help quantify site deterioration. A series of plastic reference stakes was to be placed at key intervals beneath the raised armor belt as a simple and inexpensive means of checking annually for indications of hull movement. The measurements would require only a flexible surveyor's tape and could be recorded

by unskilled personnel. Because of poor diving conditions, the stakes could not be installed during the MARSS expedition but were installed and measured a month later by a privately funded expedition as described below.

The 1995 MARRS Expedition

Because of the difficulty and expense involved in conducting research on the *Monitor*, no on-site operations were conducted during 1994. From 12 August to 2 September, the 1995 *Monitor* Archaeological Research, Recovery, and Stabilization Mission (MARRS'95) took place. Among the participants were NOAA, the U.S. Navy, the Mariners' Museum, the National Undersea Research Center/University of North Carolina at Wilmington, and Key West Diver, Inc. MARRS'95 consisted of two segments: one, a NOAA diving reconnaissance operation; the other, a major effort to stabilize the *Monitor's* stern and remove and recover its propeller. The skeg, which once supported the propeller and rudder, was torn loose from the lower hull by the anchor of a private fishing boat. The skeg now lies off to the side exposing the aft end of the machinery space and providing no support to the propeller.

MARRS'95 was interrupted by Hurricane Felix, forcing the NOAA dive team to evacuate Hatteras on 15 August. NOAA divers returned to Hatteras on 19 August, where they were joined by the Navy salvage tug USS *Edenton* (ATS-1). Once the *Edenton* established a four-point moor over the *Monitor*, it deployed a 3000-lb. stockless anchor attached to a subsurface buoy to serve as a heavy mooring for future expeditions. The mooring was positioned using the smaller NOAA mooring buoy as a reference.

On 24–25 August, both NOAA and the Navy conducted initial reconnaissance dives on the *Monitor*. As the final step in a program of extensive preparation and training, the NOAA team completed a series of self-contained mixed-gas dives—the first such dives ever conducted by NOAA. These experimental dives, approved for

assessment and evaluation purposes, utilized open-circuit scuba equipment especially configured for redundancy and safety and utilized *Monitor* tri-mix for the bottom gas. Decompression was accomplished in the water column using NOAA Nitrox II and pure oxygen, following tables developed specifically for the *Monitor* Sanctuary (NOAA 1995; Broadwater 1996).

The Navy dives—employing the Mk 21 mixed-gas, surface-supplied dive system—were staged from the *Edenton*. Navy divers initiated a planned series of tasks designed to carefully recover the *Monitor's* propeller. A Kevlar strap was wrapped around the propeller and shaft, and the propeller blades were freed from the encrustation and marine growth that attached them to the hull. The growth was chipped from the portion of the shaft that was to be cut, but on 2 September, before the cut could be made, storms forced the *Edenton* to leave the sanctuary and return to its base in Little Creek, Virginia. The *Edenton* later returned to the site, but after Navy divers had cut nearly half way through the shaft, the threat of additional severe weather once again forced an early termination of the mission. NOAA and the Navy are coordinating plans to complete the propeller recovery as soon as possible. When the propeller is recovered, it will be transported to the Mariners' Museum, Newport News, Virginia, where it will be conserved and placed on exhibit. The Mariners' Museum is the official museum for curation and interpretation of the *Monitor* collection of artifacts and archival material.

Neither NOAA nor the U.S. Navy conducted dives during 1996 due to equipment unavailability. However, through a partnership between NOAA, the Navy, HBOI, and Raytheon Company, an imaging survey was conducted in October 1996 using an advanced laser line scanner. The laser system was mounted on the HBOI submersible *Clelia*, which was piloted over the *Monitor* during repeated passes, recording the laser imagery on each pass. Again, adverse weather and poor visibility hampered the expedition and only part of the wreck was imaged.

The data were still being processed at the beginning of 1997, and a second laser survey is planned for 1997.

Private Research

Since 1990, NOAA has issued permits to private sector divers to conduct research at the *Monitor* National Marine Sanctuary. Research accomplished by private groups in recent years has contributed to the body of knowledge on the *Monitor* (Farb 1992; Broadwater 1996). However, these divers have also stirred controversy. In the beginning, nearly all of them made their dives breathing compressed air which, at the *Monitor's* 71-m depth, is considered by dive training organizations—and most recreational divers—to be extremely unsafe. NOAA has always been concerned that air divers, impaired by an advanced level of nitrogen narcosis, pose a risk of damaging the *Monitor* from inadvertent contact, both by the divers and their bulky equipment. In recent years, however, more and more of the divers have begun diving with mixed gases and using technical diving techniques suitable for the *Monitor's* depth, thus improving dive safety and increasing the quality and quantity of research results. NOAA is anxious to encourage partnerships with private organizations for the conduct of *Monitor* research but only under conditions which provide maximum safety for all personnel and will not result in adverse effects on the wreck.

Several private diving expeditions have installed reference stakes and taken measurements, photographs, and videotape. Working in concert with the sanctuary manager, a trained nautical archaeologist, these groups have even mapped and recovered loose artifacts that were in danger of being damaged or lost.

Summary and Conclusions

In spite of persistent weather problems at the *Monitor* National Marine Sanctuary during 1993, 1995, and 1996, NOAA succeeded in documenting recent hull deterioration, assessing the condition of the turret, deploying two permanent

moorings, evaluating new diving and imaging technology, recording approximately 16 hours of high-resolution videotape, and recording images of the *Monitor* with a new prototype laser line scanner. These data are being processed, compared, and combined in order to generate an accurate, up-to-date map of the *Monitor*.

Because recent expeditions have revealed an increased rate of deterioration of the *Monitor's* hull, NOAA is reexamining all management options, including the possible need for eventual recovery of major hull components in addition to the propeller. Among the options being considered for the *Monitor* are continued assessment, additional artifact recovery, hull stabilization, and possible recovery of larger hull components such as the turret. Before the end of 1997, NOAA will submit to Congress a comprehensive, long-range plan for management and preservation of the *Monitor*. This plan will review all viable options, recommend a preferred option, and outline the procedures, costs, and schedules for pursuing that option.

ACKNOWLEDGMENTS

Dive supervisors for the 1993 MARSS expedition were Dr. Morgan Wells, director of NOAA's Experimental Diving Unit, and Cliff Newell, chief of the NOAA Dive Center (NDC), Seattle. The dive team, headed by sanctuary manager John Broadwater, included NOAA divers Cheryl Callahan, Robert Finegold, Linda Moroz, and Steven Urick, and two divers from the private sector, Roderick Farb and Daniel Gouge. Assisting topside were Randall Schneider, Cheryl Graham, and Bruce Terrell, all from NOAA's Sanctuaries and Reserves Division (SRD). Sanctuary education coordinator Dina Hill provided logistical support onshore, and Brian Gorman, NOAA Public Affairs, assisted with press and visitor coordination. For HBOI, Don Liberatore was operations director, and Captain Christopher Vogel was master of the *Edwin Link*. The Commander, Submarine Force Atlantic, U.S. Navy, tasked the USS *Ortolan* (ASR-22) to establish the temporary site mooring; additional mooring equipment was provided by the Navy's Supervisor of Diving and Salvage. Very helpful advice was also offered by NOAA's National Data Buoy Center.

Among the participants in MARRS'95 were NOAA's SRD and NDC; the U.S. Navy's Combat Logistics Group Two, Supervisor of Salvage and Diving, and Naval Sea Systems Command; the Mariners' Museum;

the National Undersea Research Center/University of North Carolina at Wilmington (NURC/UNCW); and Key West Diver, Inc. The Navy salvage tug USS *Edenton* (ATS-1), under Comdr. John Paul Johnston, conducted on-site operations with dive support from Mobile Diving and Salvage Unit Two (MDSU-2), Little Creek, Virginia. NOAA dive operations were supervised by Clifford Newell, NDC, and William Deans, Key West Diver, Inc. The dive team consisted of NOAA divers John Broadwater, David Boyd, Lt. Comdr. Craig McLean, and Lt. Michael Hoshlyk; NURC/UNCW divers Douglas Kessling, Sharon Kissling, and Thomas Potter; and from Key West Diver, Inc., William Deans, Daniel Burton, and Barbara Lander. NOAA diving operations were conducted from the NURC/UNCW research vessel *Elusive*, Daniel Aspenliter, master. John Pemberton, the Mariners' Museum, served as mission photographer. Conservator Herbert Bump, International Artifact Conservation and Research Laboratory, Inc., provided on-site conservation support. Dina Hill again provided onshore logistical support, and Justin Kenney, SRD, and Lori Arguelles, director of NOAA Public Affairs, provided press and visitor coordination.

The 1996 laser imaging survey was made possible through the cooperation of Dr. Steve Ackleson, Office of Naval Research, U.S. Navy; Dr. Michael Strand, Coastal Systems Station, U.S. Navy; Dr. Bryan Coles, Raytheon Corporation; and Timothy Askew, HBOL. The survey was conducted from the R/V *Edwin Link*, Daniel Schwartz, master, and the submersible *Clelia*, Timothy Askew, Jr., pilot.

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Steamboats in Montana: Wrecks of the Far Upper Missouri–Yellowstone River Drainage Area, Phase I—The Search for Historical Evidence

Introduction

Although public fascination with steamboats is immense, only two examples of recovery of Missouri River steamboats have been reported to date: the *Bertrand*, excavated in 1968, and the *Arabia*, salvaged in 1989. These two vessels provide vital insight into the use of steamboat transportation in the American westward movement. Steamboats such as these brought mail, supplies, and equipment to homesteaders and rural communities along the Missouri and Yellowstone rivers, thus becoming the lifeblood of the rural river west. These boats comprise Montana and the Upper Missouri's nautical heritage (Petsche 1974; Hawley 1995; Kjorness 1995).

At present, research indicates that there is a minimum of 35 possible steamboat wrecks along the Missouri and Yellowstone rivers in Montana (Figure 1). Few, if any, of these have been properly verified, recorded, or investigated. Yet they are important archaeological resources, many of which are located on public lands. These historic archaeological resources offer a variety of opportunities for interpreting steamboat traffic on the nation's interior rivers. Past experience suggests that the process of examining and recording these sites will enhance the ability of federal, state, and local agencies to manage these resources, contribute to the understanding of cultural history, and better interpret this rich history to a variety of audiences.

Standard steamboat sources include lists of wrecks, but the lists do not always correspond. Survey maps of the rivers exist, some of which identify and locate wrecks, but changes in rivers

create problems for re-locating these sites. Ninety-eight percent of the boats that sank in Montana are not properly recorded as archaeological resources. The problem was to develop a basic research initiative that addressed the issue of which boats had sunk within the study area. Where, when, why, and how did they sink? What did they carry, what went down with them, and were they salvaged at the time they sank or since? What, if any, of the steamboats and cargoes may still survive at the site? And to what extent can the archaeological record of steamboat history in Montana be documented?

Four-Phase Plan

The Museum of the Rockies is taking a critically needed step toward identifying, interpreting, and preserving Montana's nautical resources by initiating a project to inventory the wrecks of the Far Upper Missouri–Yellowstone drainage area. Steamboats in Montana is a multiyear, problem-oriented research project with a four-phase plan (Karsmizki and Kjorness 1996).

Phase I examined both published and primary sources of steamboat sinkings. A list of steamboat wrecks within Montana's borders on the Missouri and Yellowstone rivers was compiled and placed in a multiuse database system (MOR). This database includes all steamboats reported wrecked on the entire Missouri River, from St. Louis to Fort Benton, and the navigable stretch of the Yellowstone River. In 1997, the database will be made available in both a published copy and through the internet for other researchers. Phase II will analyze changes in the Missouri and Yellowstone river valleys over the past 137 years to determine the meandering of the river channels. Primary sources include historic maps, notes from government-sponsored surveys, and photographs from the 19th century. These sources will be digitized and compared with modern topographical maps and USGS data. Phase III will test assumptions regarding wreck locations. A field survey will attempt to more precisely document site locations and conditions, river landscape, and current land ownership in order to facilitate site access and estab

lish present ownership of wrecks and cargoes. Finally, the survey will try to determine the impact of human and environmental forces on historic steamboat sites in Montana. Phase IV will consist of the archaeological testing of a number of steamboat wreck sites within the study area (Karsmizki and Kjorness 1996). Funding for Phase I of this project was provided jointly by the J. Mack Gamble Fund, administered by Sons and Daughters of Pioneer Rivermen, and the Museum of the Rockies.

Phase I—Historical Research

Textual Sources

Phase I of this project did not prove as simple as first anticipated. There are standard references available for this type of investigation. The three most widely used references are Hiram M. Chittenden's (1897) "List of Steamboat Wrecks on the Missouri River from the Beginning of Steamboat Navigation to the Present Time," William M. Lytle and Forrest R. Holdcamper's (1975) *Merchant Steam Vessels of the United*

States 1790–1868, and Frederick Way, Jr.'s (1983) *Way's Packet Directory 1848–1983*. Other published lists include W. J. McDonald's (1927) "The Missouri River and Its Victims," Phil E. Chappell's (1906) "River Navigation: A History of the Missouri River," and Joel Overholser's (1987) *Fort Benton: World's Innermost Port*. Analysis of these sources provided a starting point for an inventory of steamboat wrecks in the waters of Montana's two major rivers.

Twenty-six individual steamboat wrecks within Montana's borders were listed in these six sources: 11 in Chittenden, 16 in Chappell, 21 in McDonald, 5 in Lytle-Holdcamper, 13 in Way, and 15 in Overholser. Where did the data included in these lists come from, and how reliable is the information? A closer examination of these lists brought to light other important questions. How can one explain the disparity in the number of wrecks reported in the published sources? Why does McDonald list 21 Montana wrecks in his 1926 publication, but the 1975 Lytle-Holdcamper publication lists only five Montana wrecks? The answer lies in the way the



FIGURE 1. Map of Montana showing locations of reported steamboat sinkings.

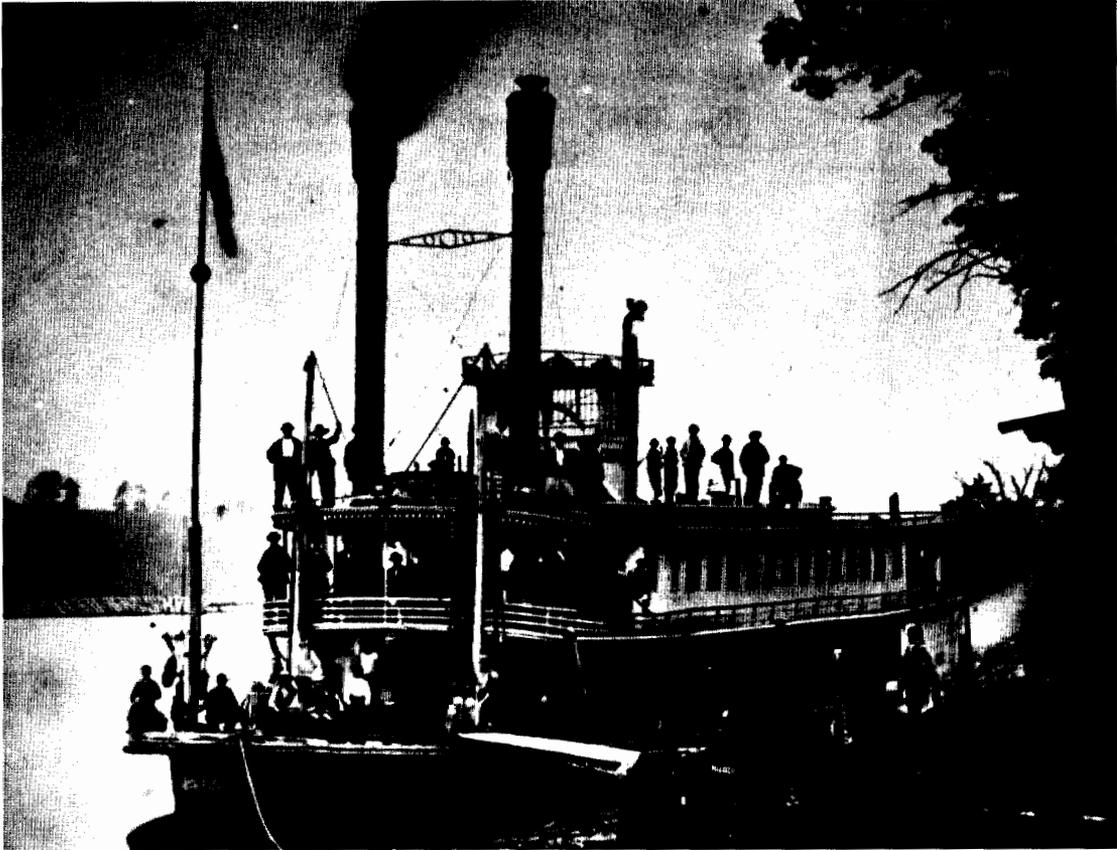


FIGURE 2. The steamboat *Chippewa*, the first Montana steamboat sinking reported. (Courtesy of the Murphy Library, University of Wisconsin-La Crosse.)

authors gathered and compiled their information. Chittenden, Way, Chappell, Overholser, and McDonald used a combination of oral interviews with old steamboat captains and reported information. Lytle-Holdcamper relied exclusively on information available in government documents. They did not search beyond the official merchant marine documents of the United States (Lytle and Holdcamper 1975).

Given the fact that several of the sources compiled lists using oral history as well as printed material, why is there still a significant range in estimates of vessel sinkings in Montana? What steamboats appear in common in the lists and which boats are different? What do the differences in the lists tell us? Other than in McDonald, the lists exclude most 20th-century

wrecks. The type of boat is also significant in the lists. Dredge barges, ferries, and snag boats are typically absent from all lists except for McDonald's. McDonald also included motor paddle wheelers in his list and boats that operated only in Montana. Often, these more obscure vessels were not included in the other lists.

McDonald, as it turns out, was an official of the Steamboat Inspection Service in the St. Louis office. This fact may make McDonald the most reliable source for information, and his list is the most complete regarding steamboat losses on the entire Missouri River, not just losses in Montana. Another notable point is that McDonald published his list in 1926. As an official of the federal government, he partially compiled his list from documents generated within the Steamboat

Inspection Service. The present authors' search of federal repositories in Kansas City, Missouri, and Washington, DC yielded records for only five Montana sinkings. The records McDonald used appear to have been lost or misplaced since 1926. Where are these records now? The answer to this question is not only important to the work on the Missouri but has implications for research regarding the Upper Mississippi River region as well.

A second class of inventory is unpublished lists located in a variety of archives. The Kansas City National Archives Branch contains a document titled "List of Steamboat Wrecks on Missouri River from the Beginning of Navigation to July 1941." This list documents 345 wrecks on the Missouri between 1819 and 1900. The majority (62%) of all wrecks went to the bottom of the river due to snags. Ice and fire accounted for slightly more than 10 percent each. Fire caused the sinking of the *Chippewa*, the first steamboat lost in Montana (Figure 2). The remaining 18 percent of steamboat wrecks were attributed to rocks, boiler explosions, bridges, piers, stranded vessels, and a variety of other causes. Of these 345 wrecks, fewer than 8 percent were raised, repaired, and returned to service; it follows that 92 percent of these wrecks were not raised or removed (Kansas City National Archives [KCNA] 1941). These wrecks comprise the nautical heritage for the Upper Missouri region.

These 1941 statistics were compared with Louis C. Hunter's 1949 assessments and the museum's steamboat database. Hunter tabulated a total of 1,235 accidents on the Mississippi River system (exclusive of the Ohio River system). Of this total, 33 percent of all the wrecks were the result of snags. Fire, collision, and foundering accounted for approximately 20 percent each. Boiler explosions contributed only 8 percent of steamboat losses (Hunter 1949). The museum's database currently contains 1,063 wrecks reported on the Missouri and Yellowstone rivers. Of this total, 26 percent of all wrecks were the result of snags. Fire and ice contributed to approximately 18 percent each, and 4 percent of the wrecks were due to collisions (Figure 3). These data are

more in line with Hunter's results for the Mississippi River. This information is important to the study because historical data suggest that the cause of sinkings directly relates to the probability of salvage and the condition of the wreck as a potential archaeological site.

Six additional archival sources also proved vital to this project: the Montana Historical Society in Helena; Joel Overholser's files housed at the Montana Agriculture Museum at Fort Benton, Montana; the Ruth Ferris Collection and the Fielding L. Wooldridge (1930) manuscript list in the Inland Waterways Library at the St. Louis Mercantile Library; the Missouri Historical Society in St. Louis; and the E. B. Trail Collection at the Missouri State Historical Society in Columbia, Missouri. The Ruth Ferris Collection documented six wrecks in Montana, while the Wooldridge (1930) manuscript provided information previously unseen for 10 of the Montana steamboat wrecks. The E. B. Trail Collection

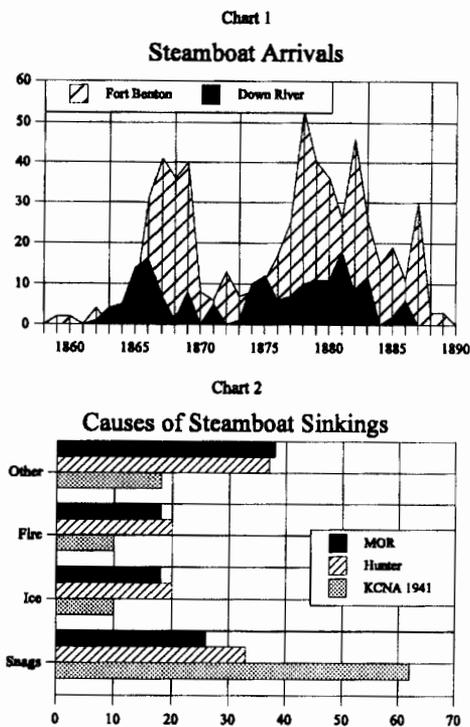


FIGURE 3. Chart 1—Steamboat arrivals at Fort Benton and down river from 1859 to 1890. Chart 2—Causes of steamboat sinkings.

contributed a wealth of data. Notes kept by Trail included 13 Montana sinkings. Like the authors of published material, E. B. Trail and Fielding Wooldridge both compiled their lists by interviewing steamboat captains and collected information concerning all boats that traveled the Missouri River. These sources represent well over a century of steamboat history, lore, and reminiscences.

Government documents provided further clues. These documents were initially expected to be one of the best sources available. The National Archives in Washington, DC and the branch repository in Kansas City both have extensive records related to American navigation activity that correlates to the Mississippi-Missouri drainage basin. Both of these sources proved frustrating and disappointing. Record Group 41, Records of the Bureau of Marine Inspections and Navigation, and Record Group 77, Records of the Office of the Chief of Engineers, are found in both locations. Neither archive has a complete set of either record group. Examination of indexes of vessels over 20 tons, licenses, enrollments, notices of surrenders, and accident reports made to the engineers commissioner quickly revealed that many records have been lost within the federal archives facility, never made it to the federal repository, or were simply never kept. Of the 34 wrecks reported in Montana, only five have turned up so far within the federal records. Of the five wrecks located in federal repositories, four appear only within federal records and do not appear in any published documents. Dates of sinkings, dimensions, number of decks, ownership, and registration records, although tremendously valuable for research, are limited in government archives.

Newspaper accounts proved useful although time consuming to access. The best sources included, but were not limited to, the *Benton Weekly Record*, the *Helena Independent*, the *River Press*, and the *St. Louis Globe Democrat*. The newspaper search was supplemented by examining files at the Missouri Historical Society, the St. Louis Mercantile Library, and the office of the *Inland Waterways Journal*. These files often cite specific newspaper references that pro-

vide obscure information, such as “Elmer Werner says he has located the wreck of the *Red Cloud*, a river steamer sunk in midstream some 40 or 50 years ago (*Helena Independent*, 8 June 1920:12),” thus eliminating a potentially lengthy search.

Photograph Collections

Photo archives or collections were examined to gain information concerning modifications of vessel structure over time. The photo collections of Joel Overholser, the *River Press*, Ruth Ferris, the Murphy Library, the Missouri Historical Society, and the Montana Historical Society all proved useful in supplying photographic documentation. An example of the importance of this research is the case of the *Red Cloud*. When built in 1873, the *Red Cloud* had three decks; these decks appear in both photographic and vessel registration information (KCNA 1877–1878b; Murphy Collection 1873). However, the steamboat was lengthened in 1877 and re-registered. The new registration documents the change in tonnage and states that the boat now has only two decks because the texas deck was removed (KCNA 1877–1878a). Yet, a photo labeled 1880 from the Murphy Collection at the University of Wisconsin, La Crosse, clearly indicates that the texas deck was not removed (Murphy Collection 1880).

Historic Maps

The second most influential resource in this study is a variety of historic maps. The “Map of the Missouri River from its Mouth to Three Forks, Montana” (National Archives [NA] 1892–1895) contains 23 individual maps pertaining to Montana. A detailed examination of the individual maps yielded a variety of evidence related to the river (including the location and depth of the stream bed, channel, and snags), the natural and cultural landscape (such as names of tributaries, bluffs, towns, and settlers), the influence of steamboats in river nomenclature (at least 12 river locations are named for steamboats or pilots; for example Spread Eagle Bar, Marion

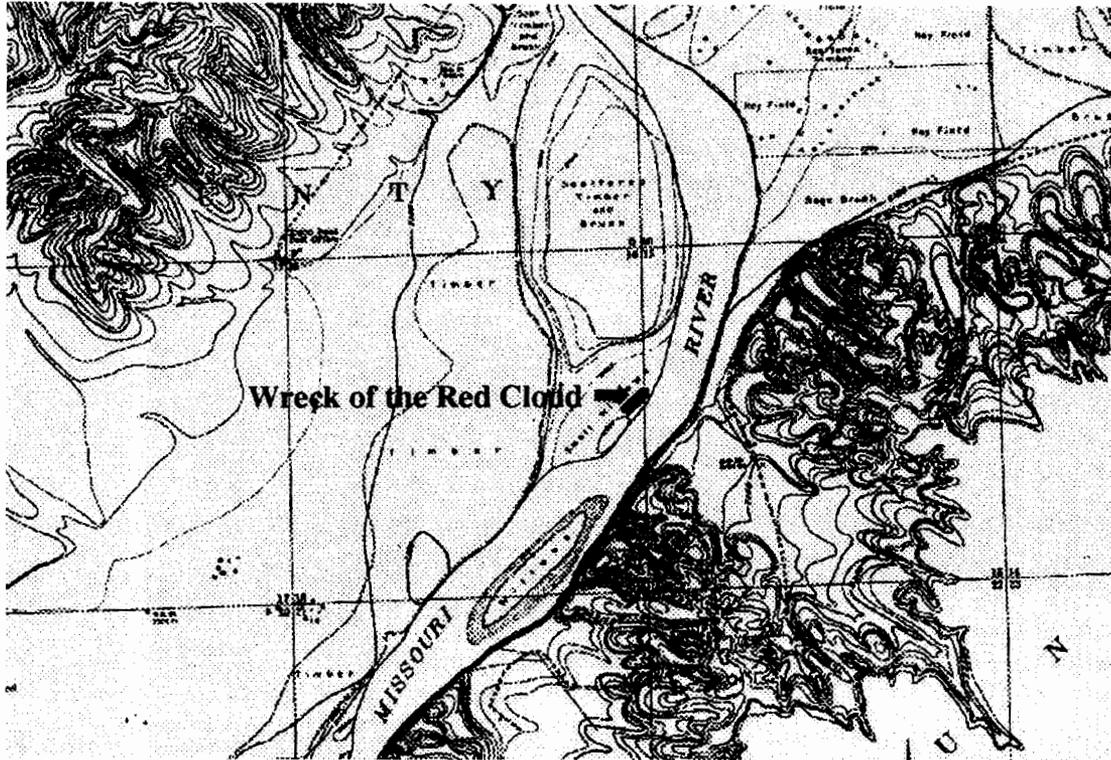


FIGURE 4. Chart 18 of the 1934 Fort Peck Reservoir survey (U.S. Engineer Office 1934) with the wreck of the *Red Cloud* superimposed on it from an overlay of the 1892–1895 Missouri River Commission map (NA 1892–1895).

Bend, Nick Wall Point, and Nick Wall Bar), and the sites of steamboat wrecks (the wreck of the *Red Cloud* in what became known as Red Cloud Bend).

A key document for research using these and similar sets of Missouri and Yellowstone River maps has been the index sheets for the 1892–1895 maps (NA 1892–1895). The index sheets are usually not detailed enough to show wreck sites, but they serve two very important functions. First, the index sheets can quickly lead to the specific maps that illustrate an individual section of the river. Montana's stretch of the Missouri is found on map sheets 60 through 83, with the most important stretch, from the mouth of the Yellowstone to Fort Benton, on map sheets 60 through 75. Comparison of individual map sets is helpful in recognizing name changes of rivers and creeks. Second, they provide an overview of the entire river including localities

recognized at the time the maps were produced. This last point is critical since often steamboat wrecks are noted by common river locations for the time, locations which may be ambiguous to modern readers. These references, however, may not provide the most obvious information, such as the state in which the sinking occurred. In order that obscure reference points can be quickly accessed, the project has created a database with more than 1,095 entries using the historic location names obtained from the 1892–1895 maps, the steamboat lists, and other historic maps. As with the steamboat database, there are plans to make the river locations' database available on line and in published format for more researchers in the coming year.

One disappointing feature of the maps is that the majority of the steamboat wreck sites are not included. Examination of a set of maps identified as the "Sketch of the Missouri River from the

Mouth of the Platte to Ft. Benton" yielded the location of the wreck of the *Trover*, sunk in 1867 (NA 1867:Sheet 16). But the compiled data suggest that by 1867, at least three other steamboats had sunk which were not recorded on the 1867 survey. The 1892-1895 set of Missouri River maps illustrates the locations of only three steamboat sinkings in Montana: *Amelia Poe*, sunk in 1868; *Red Cloud*, sunk in 1882; and *Big Horn*, sunk in 1883 (NA 1892-1895:Sheets 62, 64, 66). By 1892, 19 steamboats were reported as lost on Montana's stretch of the Missouri River. Hiram Chittenden's (1897:Appendix D) map depicts nine of the 19 (47%) reported wrecks. To Chittenden's credit, his map is the most complete charting of the Montana wrecks available in the historical sources.

Although the maps illustrate only a few wreck sites, they have other research uses. These maps are valuable for documenting changes in the river's course as well as in locating historic sites adjacent to the river. Equally important, when they are combined, the various surveys of the rivers provide significant data regarding stability and/or change at specific river locations over time. This comparative analysis will be critical in Phases II and III. Such a comparison, using a detail of the Missouri River Commission map (NA 1892-1895) and Chart 18 of the 1934 Fort Peck Reservoir survey (U.S. Engineer Office 1934), demonstrated that the river channel moved south, away from the wreck of the *Red Cloud*. One might expect an island to form around the wreck. This is consistent with the *Helena Independent* (8 June 1920:12) article in which Elmer Werner claims to have located the wreck of the *Red Cloud* in an island formed as a result of the river meandering around the wreck. The 1934 survey shows that the island was absorbed into the surrounding landscape (Figure 4). Finding the wreck of the *Red Cloud* is further complicated by the creation of Fort Peck Reservoir. The wreck of the *Red Cloud* now lies in the reservoir under 120 ft. of water.

Summary

The search for steamboat wrecks in Montana has proved both successful and enlightening regarding the historical record for steamboats on the Upper Missouri. One of the most important questions that this study has raised concerns how the wreck lists were compiled and how wrecks were located on the maps. E. B. Trail, Fielding Wooldridge, Joel Overholser, Ruth Ferris, W. J. McDonald, and Hiram M. Chittenden all used local informants to help compile their lists. How reliable or accurate is this information? Ultimately, it must be remembered that a single source will not provide all of the information. Most important is the need for comparative scrutiny. How close is the information to the actual location of the steamboat wreck? How large will the search area have to be? Research has also shown that little-known lists of steamboat wrecks do exist. Finally, as the analysis of McDonald has demonstrated, hope remains that at least one (if not more) significant sources of steamboat data may yet be found. This steamboat data is the basis of a well-informed archaeological investigation and is, therefore, as worthy of research as are the steamboats themselves.

ACKNOWLEDGMENTS

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The Development of Maritime Archaeology in Northern Ireland

Northern Ireland is part of a small island off the European western seaboard, located at 54° N and 6° W. Because it is an island, all of its communications with other regions throughout human history have involved maritime activity. The coastline is small but varied in character and has been exploited over many generations; there is still a strong maritime tradition among the people. For a period of about 100 years until the 1960s, Belfast had the largest shipyard in the world and is perhaps most famous for building the ill-fated *Titanic*.

Government has been responsible for archaeology in Ireland since 1882, and the subject is firmly established in universities and more recently in the private sector. Surprisingly, government in Northern Ireland has only had a responsibility for maritime archaeology since 1992, when it made an agreement with the Department of National Heritage in London to take administrative responsibility in Northern Ireland waters for the United Kingdom-wide Protection of Wrecks Act 1973.

A basis of knowledge was required for management of the maritime resource, and Environment and Heritage Service funded a Senior Fellowship in the Queen's University of Belfast to create a Maritime Record. The main brief was to create a computerized database of all archaeological sites in Northern Ireland's coastal waters. The first stage of the Record—accumulating all the available data from documentary, cartographic, and illustrative sources—has been completed.

Documentary, Cartographic, and Illustrative Sources

The main documentary sources used include wreck lists, harbor plans, and shipping information from the Commons Sessional Papers, the annual proceedings of Parliament, which have

been published since 1800. The shipping information from this source was supported by Lloyds Register and Lloyds List, published since 1740. Wreck information was also extracted from Northern Ireland's local newspapers servicing coastal communities. Various annals and medieval texts were searched. One of the more interesting references comes from the Annals of Ulster for the year A.D. 924, which refers to a great fleet of Viking ships foundering in Dundrum Inner Bay.

The Hydrographic Office in the British Admiralty has been producing charts of Northern Ireland's waters since early in the 19th century. These charts record the position of numerous wreck sites as well as coastal landing places. Ordnance Survey maps and supporting early 19th-century memoirs, Royal National Lifeboat charts, and estate maps have all proved valuable sources. Work has also been undertaken to catalog the considerable body of paintings, drawings, and photographs of maritime subjects.

The Maritime Record has now completed the documentary phase and contains evidence of some 3,000 wrecks as well as a large archive on other maritime sites. While this is a useful starting point, as it stands the Maritime Record does not fully reflect the potential of maritime archaeology in Northern Ireland. The information is very limited in time, effectively covering only the years A.D. 1740-1945, while humans have occupied the island for at least 9,000 years. A second problem is that the evidence for locating wrecks is often poor.

Geophysical Survey

Net-fastening data, kindly donated by local fishermen, have gone some way to provide non-time-bound information which is well located, but the thousands of possible sites on disk have yet to be integrated into the Record. Environment and Heritage Service now funds research in the University of Ulster to conduct a geophysical survey over a 3-year period around the coast of Northern Ireland. This project will produce a geomorphological map of the seabed including cultural data using sidescan sonar, magnetometer,

and subbottom profiler with locational information plotted using a single frequency GPS mapping system. As most wrecks lie in shallow water, a program of research on shallow-water prospection is being supported in the Department of Oceanographic Science, University of Southampton, England. Ground truthing of the geophysical evidence will be undertaken at a later date.

Archaeological Excavations

The first underwater archaeological excavation took place in isolation in the 1960s when Belgian diver Robert Stenuit investigated the Spanish Armada galleass *Girona*, which sank off the north coast in October 1588. The material from his project forms the basis of the magnificent collection of 16th-century Spanish Armada artifacts in the Ulster Museum. Twenty-six Spanish Armada vessels are known to have been wrecked on the Irish coast on their long homeward journey around the north of Scotland and along the west coast of Ireland after failing to invade England in the summer of 1588. The 1960s excavation stood in isolation, and another generation was to elapse until a second shipwreck was excavated in 1995.

The *Taymouth Castle* was bound from Glasgow to Singapore and left Broomielaw in Scotland on Thursday, 3 January 1867. It was carrying a valuable general cargo which included 738 gallons of wine and spirits, 74 barrels of beer, £42,370 worth of cotton, £511 worth of earthenware, £2,926 worth of iron and metal building materials, £110 worth of saddlery, and £2,000 worth of sundry articles.

The *Taymouth Castle* had been built 2 years previously in July 1865, at Glasgow, by the Connell company and registered with Lloyds in August as A1. It was a fully rigged ship with three masts with square sails. The vessel was an experimentally built composite ship, with iron framing, wooden planking, and yellow-metal sheathing.

On Saturday, shortly after leaving port, the vessel got into difficulties in severe gales that swept across the North Channel. It was wrecked that night on the northeast coast of Ireland. The wreck site lay undisturbed for more than 100 years until sport divers proved a threat to the site in the 1990s. As a result, Environment and Heritage Service conducted its first underwater excavation in September 1995.

The investigation recorded the surviving structure of the vessel and excavated two trenches across the cargo mound. Iron framing was found conforming to the known dimensions of the vessel. A large windlass of iron and wood was found with a taut chain still in position indicating that an attempt had been made to anchor the ship to keep it off the shore. Excavation of the cargo mound recovered piles of iron cooking bowls which had rusted and helped form a concretion which preserved much of the cargo. There was a great deal of evidence of bottles of alcohol, with makers marks on the bottles indicating a Scottish origin. Similarly, the profusion of pottery on the seabed was all Glasgow spongeware. The importance of the project was that it marked the beginning of underwater excavation by government in Northern Ireland.

Intertidal Archaeology

Faced with interesting studies of the archaeology of the intertidal zone elsewhere in Ireland and Britain, Environment and Heritage Service has responded by conducting two pioneering seasons of fieldwork in Strangford Lough in 1995 and 1996. Systematic searching of the shore found evidence of sea level change and submerged 8,000-year-old Mesolithic period landscapes. Sites relating to communications in the form of boats, landing stages, and harbors were encountered in profusion. Agricultural exploitation of the shore was found in the form of field boundary extensions and farm quays. The harvesting and processing of seaweed as fertilizer and the production of kelp were recorded. Kelp

grids for the growth of seaweed, kilns for burning to make potash, and kelp stores were found to be part of the coastal repertoire.

Fishing from boats was known to have been conducted in the 18th century when historical records indicate there were 150 vessels on the Lough, but no archaeological evidence survived of this activity. A variety of types of fish traps were located in the intertidal zone. These are massive structures designed to catch fish on the ebbing tide. Stone traps close to 6th-century monasteries indicate the possibility for an early construction. Wooden traps are more readily dateable, and a group of V-shaped traps have provided radiocarbon results from the 7th to the 12th centuries. Stone traps are more difficult to date, but a group of V-shaped stone traps show stratigraphical evidence of being more recent than the wooden examples and are thought to

belong to the nearby Cistercian monastery in the medieval period.

Summary

In a 4-year period, Environment and Heritage Service has moved into studying coastal archaeology and has found a great deal of material of cultural significance. The plan now is to consolidate the information gathered and seek to protect the resource. On the basis of knowledge already gathered, the private sector has been involved significantly in surveying areas planned for development and providing mitigative measures to protect or record the material.

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The 1995 Survey of a Ship from Sir William Phips's Fleet, 1690

Introduction

On 24 December 1994, Marc Tremblay, a sport diver from Baie-Comeau, Quebec, discovered in front of his cottage the remains of a wreck that would prove to be one of the vessels of Sir William Phips's 1690 expedition against the City of Quebec. Immediately, he notified the Ministère de la culture et des communications du Québec (Quebec's Ministry of Culture and Communication) and Parks Canada's Underwater Archaeological Services.

The wreck was discovered in a small cove named anse aux Bouleaux, or Birch Cove, approximately 100 km east of Baie-Comeau on the north shore of the Gulf of St. Lawrence. It lies in very shallow water, the depth of which varies from 1 to 5 m depending on the tide. A late autumn storm had shifted the sandy bottom, thus exposing the remains. Upon discovery, the remains were found to be very vulnerable to subsequent storms, and the imminent freezing over of the cove for the winter prompted an emergency operation in order to protect exposed remains until appropriate archaeological work could be done.

A 2-day project was conducted on 6 and 7 January 1995 by a Parks Canada underwater archaeologist supported by local sport divers (Bernier 1995). It insured temporary protection of the wreck until spring and permitted the gathering of preliminary information for the first attempts at dating and identifying the remains. Two days after archaeologists and divers completed the project, ice sealed the cove for the rest of the winter.

The artifacts visible on the site suggested a military ship, probably of British origin, dating to the end of the 17th century or the very beginning of the 18th century. Given the location of the wreck and the war context of that period, two hypotheses were favored. The first one was

that it was a ship of Sir William Phips's 1690 New England fleet which had reached the city of Quebec during the War of the League of Augsburg (1689–1697). After having failed to take Quebec, Phips had lost four vessels on his way back to Boston: Captain Rainsford's ship wrecked on Anticosti Island with 22 survivors; a second ship was lost, but most of the crew was saved by another ship; one ship wrecked with only one survivor returning to Boston; and a fourth one disappeared without a trace (Mather 1967 [1702, 1852]:192–193). The second hypothesis was that the anse aux Bouleaux wreck was a ship from Admiral Hovenden Walker's 1711 invasion fleet during the War of the Spanish Succession (1701–1713). Walker lost eight of more than 70 vessels at l'île aux Oeufs (Egg Island), only 25 km downriver from anse aux Bouleaux (Lépine 1977).

Spring of 1995 Project

A 3-week predisturbance survey was held from 29 May to 16 June 1995. The objectives were to recover the threatened artifacts, assess the site, gather information to date and, if possible, identify the wreck, and insure proper protection of the remains (Bernier 1996).

Led by a Parks Canada underwater archaeologist, the project's dive team comprised 21 divers from the Groupe de préservation des vestiges subaquatiques de Manicouagan (GPVSM), a protection-oriented submerged-resources dive group from Baie-Comeau. All divers who participated in the project had completed their Level 1 certification of the Nautical Archaeology Society's underwater archaeology training program. As they had been for the January emergency operation, the project's field costs were covered by the Province of Quebec's Ministry of Culture and Communication (MCC) through the Regional County Municipality of Manicouagan. Parks Canada supplied all the field equipment. The conservation of the artifacts recovered was done by the Quebec Conservation Center under the initiative and responsibility of the MCC.

The 3 weeks of work allowed the completion of the as-found site plan (Figure 1), critical to

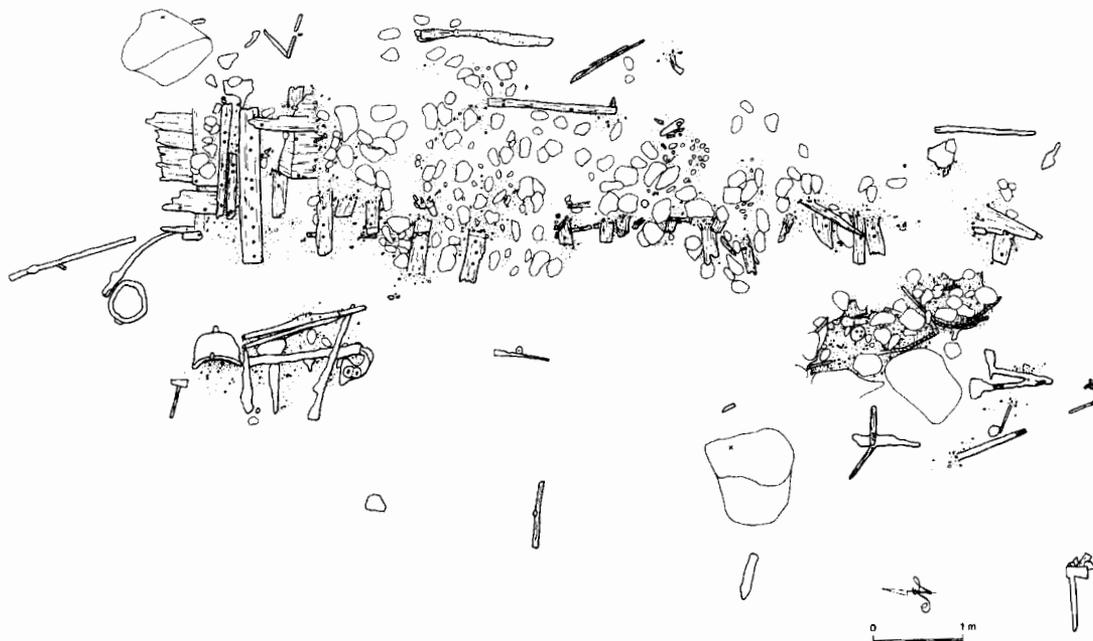


FIGURE 1. As-found site plan of the anse aux Bouleaux wreck completed during the 1995 survey. (Drawing by M.-A. Bernier.)

the understanding and the proper evaluation of the remains and for recording the artifacts to be recovered. The plotting of the artifacts was done with the trilateration method while the hull remains were drawn using an aluminum grid system with 2-x-2-m squares.

The visible site, approximately 14 x 8 m, contained an 8-x-2-m area where hull structure was partly discernible. Fractured frame timber ends emerged erratically from the sand. The north end of this area showed a 2-m-long, fully exposed section. Here, four exterior planks, 18–26 cm sided, were partly visible under the frames. Wood samples analysis showed that both exterior planks and frames were of white oak (*Quercus* spp.). Two ceiling planks, one of which was 51 cm sided, were partly exposed above the frames. Wood sample analysis of one of the planks showed it was of eastern white pine (*Pinus strobus* L.).

Numerous artifacts could be seen among the small rocks and sediment covering the rest of the distinguishable hull section: shoes, ceramic

shards, animal bones, muskets, tool handles. The area west of the hull section consisted of a vast artifact debris region. Muskets, cauldrons, axes, ceramic shards, wine bottles, and large concretions covered an 8-x-3-m zone.

In total, 43 artifacts were recovered during the 1995 project, 23 others during surveillance operations following storms in the fall of 1995. A large number of objects were visible in 1995 but could not be retrieved at the time because they were caught in larger concretions.

Artifacts related to military activity were the most numerous objects to be found in 1995. Although only three muskets or musket fragments could be recovered, at least 20 others were recognizable among the remains. The 10 or so butts visible were notably very different, one of them dating back to the first quarter of the 17th century. A majority of guns had brass furniture, and many of them showed a personalized touch, either through decorations or initials. One musket lock plate, extracted from a concretion, proved to be brass plated, a very unusual fea

obtaining the necessary approvals. André Bergeron of the Quebec Conservation Center was responsible for the treatment of the artifacts.

The members of the Groupe de préservation des vestiges subaquatiques de Manicouagan, divers and nondivers, played a major role from the start. Their interest and dedication are exemplary. The Regional County Municipality of Manicouagan played an important administrative role, and the town of Baie-Trinité followed with its support. Robert Gilbert and Napoléon Martin helped with the historical research, and Emerson W. Baker of Salem State College came through with some crucial historical information including the identification of Increase Modsley's wife. Thanks also to all the Parks Canada's staff members who helped out in the project.

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The 1996 Excavation of a Ship from Sir William Phips's Fleet, 1690

Introduction

A complete historical summary and site background may be found in Bernier (1996; this volume). Following the wreck's discovery in December 1994 and the 1995 survey, plans were made to excavate the site. From 8 July to 30 August 1996, Underwater Archaeological Services of the Federal Archaeology Office of Parks Canada undertook an excavation of the site at anse aux Bouleaux. Partners in this venture included the Ministère de la culture et des communications du Québec, the Centre de Conservation du Québec, the Municipality of Baie-Trinité, and the Groupe de préservation des vestiges subaquatiques de Manicouagan (GPVSM). Regular on-site staff included site director Jim Ringer, three Parks Canada archaeologists, and two student archaeologists. The staff was very ably assisted by 24 volunteer divers from the GPVSM, all of whom had completed Nautical Archaeology Society Level I course work with Parks Canada. Results of working in this partnership were extremely gratifying with exceptional work performed by the volunteer divers.

Site Objectives and Approach

The basic goals of the 1996 season were (1) to determine the extent of the site in terms of area, structure, and artifacts and (2) to excavate as much of the site as possible beginning with the extant hull. The project was considered urgent because of the endangered nature of the site. There was no question that parts of the site had been recently uncovered as evidenced by artifacts and structure. Many of the muskets

from the site had exposed, partially intact barrels. More surprisingly, clothing textile lay on the site surface. Additionally, only minimal marine borer damage was evident on the exposed wood, evidence indicating fairly recent and infrequent exposure.

Site Setup, Operations, and Logistics

During the first 2 weeks of operations, the first groups of volunteer divers were initiated to the site and participated in the basic site setup. Grids were assembled ashore, and a small support barge was anchored over the site. A flexible datum line was installed on the previous year's baseline, and then a series of 2-x-2-m grids was installed along the baseline, thus permitting expansion to outlying areas (Figure 1). Excavation took place using four water-pump suction dredges installed on the site. Two of these dredges were Couple-jets which, with extended discharge tubes, were effective in carrying sand 7–9 m off site. Excavation of the massive concretion areas was done with hand and pneumatic tools.

At the completion of the first full diving week, the site was set up and excavation had begun. Unfortunately, "the storm of the century" then hit the greater North Shore region, blowing the support barge off site, breaking datum lines, and reburying all that had been uncovered to date, including dredges and grids. Another week was then spent uncovering the site, recovering dredges and hoses, and reinstalling datums and grids. The bulk of this lost time was devoted to the extreme care needed to take sand off the previously cleared areas. Because of the very dynamic nature of the site and waves which had been breaking directly on it, one had to assume that previously excavated areas could now contain artifacts. Indeed, this assumption proved to be the case.

A total of 664 diving hours was recorded on site, split almost equally between six Parks

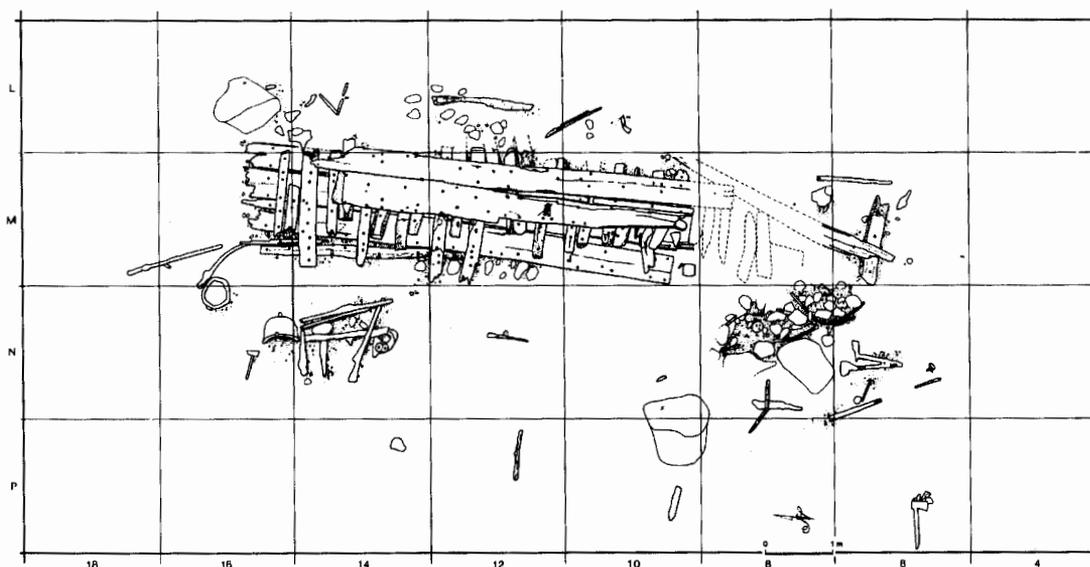


FIGURE 1. Site Plan 1996. (Drawing by M.-A. Bernier.)

Canada staff members (343 hours) and the 24 volunteer divers (321 hours). Twenty-five diving days were spent in actual excavation.

Excavation and Artifacts

The site was excavated by suboperation or 2-x-2-m area. There was no typical suboperation in terms of stratigraphy. Some areas started with concretion at the seabed, concretion which was solid for a depth of up to 54 cm followed by a dense clay sterile bed. Other areas, such as on the hull itself, were covered with sterile sand (10–60 cm) followed by scattered artifacts within a variable-depth sand layer followed by a stone layer varying from a few cm to more than 40 cm, directly atop the hull. Still other areas had continuous artifacts from the seabed surface down through 80 cm of mixed sand, gravel, and small rocks to a stone layer.

Most of the site's stone layer was very rich in artifacts from top to bottom. Off the hull, cultural sand layers in some areas started at the seabed and extended downward. The stone layer appeared to continue at least slightly below the hull with artifacts again interspersed. Research

on the stone layer to differentiate indigenous rock and ballast is ongoing. Preliminary results indicate that most of the rock recovered from the hull itself is the original ship's ballast.

The artifacts were field catalogued upon recovery and then went to site conservation facilities for interim storage/treatment. Minimal time was available onsite for any study of the materials so any descriptions should be regarded as preliminary in nature. Additionally, only three of the suboperations (Figure 1) were completely excavated; therefore, any distributional analysis or

TABLE 1
ARTIFACTS RECOVERED

Category	1996	Total ^a
Arms or related	1,102	1,114
Ship related	79	84
Life on board	281	303
Personal items	124	126
Occupation related	29	31
Concretions and others	122	128
Totals	1811	1865

^aTotal artifacts recovered in 1996 excavation plus prior surveys.

inferences should also be regarded as preliminary. Some of the definitive artifact categories are listed in Table 1.

Arms and Related Items

Of the artifacts recovered, the most obviously plentiful category is arms and related items. Of this category, the bulk of the objects recovered (more than 90%) are individual pieces of lead shot. Much of this lead shot, more than 800 pieces, is in the form of standard musket balls with sizes ranging from 0.59 to 1.91 cm ($\frac{1}{4}$ – $\frac{3}{4}$ in.) with at least three distinct size groupings in that range. Also frequently encountered was a distinct elongated or egglike shot with an average diameter of about 1.5 cm ($\frac{9}{16}$ in.). There is also a variety of smaller shot including both an intermediate buckshot and small birdshot.

Also prominent in the finds is what appears to be cylindrical shot. The solid-lead cylindrical shot is a diameter similar to the typical musket ball recovered. Initially it was questioned whether these cylindrical lead pieces were shot, but the question was answered when a leather shot or cartridge pouch was recovered containing this cylindrical shot. There seems little doubt that these lead cylinders were in use as shot. Similar shot is illustrated in France in the mid-19th century in *L'arme à feu portative française* (Cottaz 1971:245).

There are also small cylindrical shot and small cubic lead shot, but these have yet to be examined in any detail. Similar cubic shot is also illustrated by Cottaz (1971:245). One small cannonball was recovered from the site in suboperation 10M, but no cannon or other cannon-related artifacts have been noted.

Two leather cartridge-type pouches were also recovered. One of the pouches is almost complete and contained finely cut wood which appears to have originally formed a thin-wall container or pouch liner. Also contained within—and spilling out of—the pouch were a number of cylindrical shot as mentioned above.

One of the most interesting finds of the excavation is a leather bandoleer. This cross-chest

TABLE 2
1996 POSSIBLE INITIALS MATCHES

Artifact	Initials	Dorchester Company List ^a
Spoon	AW	Sergeant Ammiel Weeks
Spoon	WB	William Baker William Blake William Belshar
Gimlet	MM or WW	Matthew Mapley
Pistol	H	Corporal George Holmes
Spoon	ML	Henry Lyon Eliab Lyon Joseph Long John Lord John Leeds
Spoon	MG	John Gulliver William George

^aFrom Watkins (1898:41–42).

style broad leather belt was used to suspend a series of leather-covered metal tubes with sliding leather-covered stoppers. Historically, such tubes or pouches contained measured powder charges which could be brought quickly into service. About a dozen of these tubes are each suspended by two leather strings from the main belt. There are also a small leather pouch, likely for shot, and a crude holster, possibly for a hatchet or bayonet, associated with this collection. Some of the edging of an associated leather rectangle has been pinked, most likely as decoration. This leather rectangle may have served to prevent the suspended charges from becoming caught in other equipment or apparel during shooting or other activities. A bandoleer is clearly depicted together with directions on how to don it in the *English Military Discipline*, published ca. 1675 (cited in Wilkinson 1978:89). Bandoleers continued to be British military issue until at least the beginning of the 18th century (Blackmore 1994:31).

There were some 33 muskets visible on the site, 15 of which have been recovered. Some of these weapons were contained within concretion but those that were exposed indicate variation in manufacture. Some individual customizing or graffiti on the weapons has been noted. The variation in weaponry and customizing of same

would seem reasonable since militiamen were normally expected to provide their own firearms and some related accouterments (Leach 1973:11–13). Three pistols were also recovered from the site. Although not yet studied, it was readily evident that they are of differing sizes. A variety of flints have also been recovered.

At least two types of small axes or hatchets as well as a complete sword and leather scabbard were also excavated. In at least one of the colonies, soldiers were expected to bring a sword, bayonet, or hatchet as a part of their compulsory equipment (Leach 1973:13).

Other Artifacts

A wooden lower-valve body from a common pump was recovered from between frames on the western edge of suboperation 8M. The valve is typical of those found on vessels of the 18th century and later, as described and illustrated by Oertling (1996:24–25). This type of lower valve would not be viewed as uncommon in the late 17th century.

In 1996, a number of artifacts were recovered which have aided greatly in site and ship's personnel identification. The most definitive items in terms of site and personnel identification are the spoons. Eleven spoons were recovered, of which three have makers' marks and dates. Two of the spoons have the identical touch mark, IS

87, indicating the maker Col. John Shorey of London (Cotterell 1963[1929]:304) while the third has the mark WL 1668. In addition, the artifacts enumerated in Table 2 have initials which may match those of members of the Dorchester Company of Massachusetts.

Two of the artifact initials are obviously not a direct match, a fact which may be accountable through items given, borrowed, or traded, or items belonging to sailors, soldiers, or others onboard ship who were not members of Dorchester Company. What is clear is that this information confirms the findings of the 1995 survey: this wreck was one of Sir William Phips's ships and was the vessel that was transporting the Dorchester Company.

Numerous other diverse artifacts were excavated including wine bottles, a small ointment pot, iron cooking cauldrons, a sharpening stone, a grindstone, axe handles, tool handles, cask parts, a variety of textiles, shoes, rings, buttons, pins, rope, nine coins, a pipe with tobacco, and fish, bird, and animal bones.

The Hull Structure

During the 1996 season, no formal structural analysis of the hull was undertaken as the emphasis was on completing as much as possible of the excavation. The following is a general overview which can be expanded and revised as

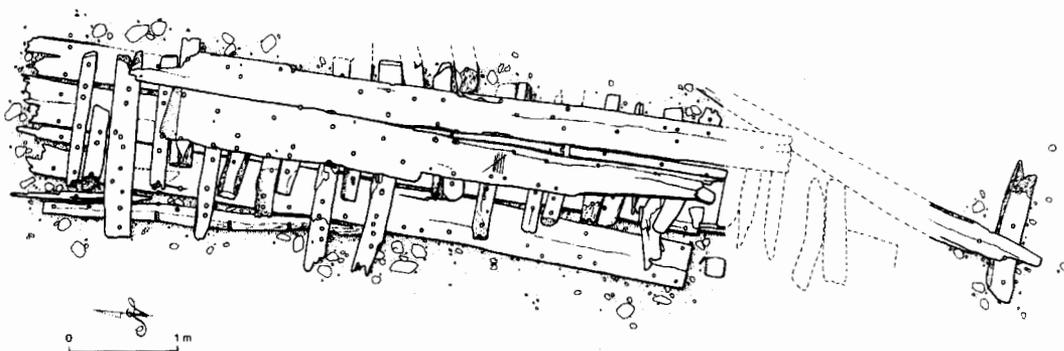


FIGURE 2. Hull plan. (Drawing by P. Waddell.)

more information becomes available. Each of the three main structural components is considered, followed by some overall observations regarding the hull.

Internal Planking

There are two major internal planks (Figure 2), one measuring 620 x 40 x 4 cm, while the other is 458 x 51 x 4 cm. Both of these planks are broken at one end; therefore, lengths are not original. The westernmost internal plank is beveled at its northern end although there is no clear evidence of scarfing to a continuing plank. Also noted on this plank is a series of five large, parallel, cross-plank incisions with a canceling line stroking through the five parallel lines. This mark appears to have been used as a tally in the construction process or, more likely, to indicate a specific point on the hull for ballasting or lading of the vessel. Wood identification on this plank showed it to be eastern white pine (*Pinus strobus* L.). The other main plank appears to be softwood as well. These two planks are tightly edge butted at the north end but start to separate about halfway through their length. This opening space is filled with three smaller planks which appear to form a "stealer" role in filling the gap created by the run of the two main planks. This feature appears to be original and not a modification or repair. Using three planks in a 2-m span suggests an eye to economy in construction. Identification of the species of these three small patchlike planks was not undertaken, but they all appear to be hardwood. All the internal planks are firmly attached with treenails, a large number of which are wedged across their diameter. The wedges are relatively large, about one-half the cross-sectional area, indicating significant tightening of the original fastening.

External Planking

There are three major external planks which average approximately 45 x 5 cm in cross section. Lengths are not determinable, but at least one may be no less than 640 cm, as there is no

evidence of plank jointing on the internal futtock faces. The south ends of the external planking are not exposed, but each plank at the north end exhibits a roughly torn off appearance at approximately the same point on the hull (Figure 2). Two of these three external planks were analyzed for wood type and confirmed to be white oak (*Quercus* spp.). One smaller fragment is of a plank whose molded dimension is approximately double the other external planks. Evidently it served a wale function. Interestingly, the north ends of this external planking have a scorched appearance on their inner face, indicating fire or heat damage. Approximately 100 m northwest of the site, two fragments of what are believed to be external planks were recovered from the intertidal zone. All of the treenail fastenings on these two planks display large wedges. Most of these wedges are square. One is a rectangular cross-treenail style as noted on the inner hull planks, and two are diamond shaped wedges not previously encountered.

Framing

There are approximately 31 futtock fragments associated with the wreckage. They tend to be more rectangular than square in cross section. The frames observed to date are consistently greater in sided than molded dimension. A typical futtock measures approximately 130 cm long x 16 cm sided x 12 cm molded. The occasional futtock has a sided dimension of as much as 26 cm, a measurement which is almost double the average. The frames that have been observed to date seem to be independent; i.e., there is no evidence yet of fore and aft joinery.

Overall Hull Observations

The wreck is oriented approximately north-south and is quite linear with extant remains covering an area approximately 2.4 x 9.7 m. The south end is not yet totally uncovered, but the length of integral hull is estimated to be in the vicinity of 8.5 m. At the north end of wreckage, there is a distinct and abrupt stoppage of structure (Figure 2). The hull remains are coherent,

well fastened, and almost perfectly horizontal. As one proceeds south, the west side of the hull begins to lift up becoming closer to vertical at the south end. Some of this approximately 35° torquing through the length of the hull may represent some original hull curvature. However, it is also possible that the wrecking process has contributed to this effect. In the central portion of suboperation 10M, a distinct change in the orientation of the futtocks may be seen. The displacement of futtocks is accompanied by severe cracking of the ceiling planking and distinctly stressed fastenings.

One of the more striking features of the extant hull is the roughness of construction. Cambium, if not bark, is evident on several frames, and there is a distinct lack of concern for standardized frame sizing in the hull. Some of the frame ends appear to be cut off where the tree swelled for branching—cutting for end-to-end grain was obviously not a concern. The lack of intention to use consistent dimensions and clear timber for the structural elements is also evident in the interior planking which displays a patchwork approach to what little ceiling planking is present. The construction of this vessel is quite obviously completely unlike military-specification vessels where consistent dimensions and dictated standards of construction are evident. It is also somewhat cruder than several of the consistently well constructed commercial vessels, from the 16th century forward, investigated by Parks Canada. It may be more related to vernacular craft. Although there is little structure to go by on the site, what is there appears to indicate a lack of concern for finished details and an economy of construction that may reflect colonial commercial shipbuilding practices of the time.

As previously mentioned, an area on the inner face of the external planking at the extreme north end of the hull has been charred or fire damaged. There is evidence that a brick hearth or oven may have been in this area as seen by the presence of two large cauldrons off to the immediate west (Figure 1) and by the predominance of brick (31 bricks or brick fragments) noted in the immediate excavation. If this area

was burned by a hearth or oven, it raises a question. Was this old damage or did it occur during the wrecking process? If the latter is true, it indicates that the wrecking was somewhat unexpected as surely the fire's coals would have been doused if the ship was in peril. It is, of course, also possible that the ship and its galley were used to prepare food after the initial wrecking/grounding.

It would not be unreasonable to expect the galley to be located in the bow region as indicated by William Baker's description of a 17th-century colonial bark (Baker 1962:92). If this region is indeed the galley area of the vessel, it indicates a possible orientation for the wreckage. One other possible location-indicating artifact is a lower valve from a ship's pump, recovered toward the south end of the hull in suboperation 8M. One would expect this artifact in the general midship area and aft of any bow galley. Hence its location is not incompatible with the hypothesis that the north or shoreward end of the vessel, containing the galley, is from the forward part of the ship. Given the relatively small vessel size (as projected from historical documentation and observed scantlings), these remains represent a significant portion of the original ship.

Site Reburial

The area to be backfilled consisted of approximately 25 m³. In the excavated areas off hull, the artifact-bearing surface was stabilized with loose sand and a layer of sandbags carefully placed by hand. More sand and additional sandbags were then used to fill the excavated areas to the original surface.

On the hull itself, there was strong concern that straight sand would not provide sufficient ballast. The concern arose from the potential for scouring and from the fact that 5 tons of rock ballast had been removed from the hull. To counteract this lack of ballast, vinyl-covered lead "doughnuts" (normally used for grid ballasting) were distributed evenly over the hull. In total, approximately 900 kg (2,000 lbs.) of lead ballast were placed on the hull.

Following lead ballasting, the hull and adjacent excavated pits were covered with a single layer of sandbags and then loose sand backfill. The loose sand was dredged from sterile areas off the site and was used to flow over and seal exposed hull and artifacts. In the reburial, 1,200 sandbags were employed averaging about 27 kg each for a total of about 23 tons. Loose sand pumped onto the site was estimated at about 27 tons. In total then, about 60 tons of sand were used for the interim site reburial. This reburial process took place over 3 days and accounted for a total of 21 diving hours or 3 percent of the total dive time. The local volunteer divers continue a monitoring program of the site conditions.

Future Work

About 40 percent of the main site area has been excavated including almost 90 percent of the extant structure. A number of options are now being considered with the prime focus on completing the main site excavation. Many different hull options have been proposed, but the current prime recommendation is to disassemble, raise, and record the timbers and then rebury them in deeper water with sand coverage and monitoring fixtures similar to those used by Parks Canada on the Basque whaling sites in Labrador (Waddell 1994).

This ship clearly offers a rich legacy in cultural material. The site presents an unparalleled opportunity to study colonial life, militia life, and munitions in use at the close of the 17th century. The opportunity to study the hull remains of what may be one of the earliest known New England ships is also unique. Furthermore, this wreck is of great Canadian significance in that it is the physical evidence of an event that permitted the domination of France in this area of North America for almost another century.

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MENSUN BOUND

A Late Elizabethan Wreck off Alderney in the Channel Islands

Introduction

During the late 1970s a crab fisherman from the island of Alderney in the English Channel (Figure 1) found a concreted musket entangled in the rope of one of his pots. Divers from the local subaqua club visited the site, which is situated about half a mile (0.8 km) to the north of the island's lighthouse, and found two iron cannon, an anchor, and some pottery fragments at a depth of 92 ft. (28 m). It was not, however, until 1991 that the club began to dive the site in earnest. During this period, further cannon were found, and a large number of artifacts (mostly weaponry and armor) were recovered. The archaeological services were alerted, and the wreck was identified as being from the Elizabethan period (Davenport and Burns 1995; Bound 1995).

The Site

An archaeological survey of the wreck began in 1993. The site was found to consist of a large sand bank, about 115 ft. (35 m) across, with rock outcrops on all sides. The main concentration of artifacts appeared to be within the mutating bank although shards, concretions, and ruptured timbers were seen between the surrounding rocks. Although visibility was fair, currents were generally strong so that diving could only take place at slack water, a window of about 40 minutes twice a day.

Hull, Fittings, and Accouterments

From the ship's hull came two rectangular ports, one of which was certainly a gunport measuring 14.6 x 18.2 in. (37.1 x 46.2 cm). It had been hung vertically on twin hinges and had an 0.8-in.-diameter (2.1-cm) hole through its lower edge. This hole would have taken an eye-

bolt for the rope that served to raise and lower the port. The only timber assemblage to be found was the vessel's rudder and part of the sternpost. They were held together by the metal straps from the four gudgeons and pintles. The surviving length of the rudder assembly was 15 ft. (4.6 m).

The remains of two anchors were seen on the site. One comprised the shank, the ring, part of the stock, and the remains of two arms. The other consisted of only the ring and the shank which appeared to have broken at the trend. Fourteen short lengths of cordage were retrieved. The majority had been hardened by iron migration, and many still smelled of pitch. Three distinct diameters were observed: 1.0 in. (2.5 cm), 0.6–0.7 in. (1.6–1.7 cm), and 0.2–0.3 in. (0.6–0.7 cm). The majority, if not all, were triple-stranded, right-handed, hawser-laid. One piece of rope seemed to have been spliced into a grommet and contained the remains of a concreted iron eye or thimble.

Two lead scuppers—11.2 in. (28.5 cm) and 13.0 in. (32.9 cm) long and flared at one end—were recovered. One drop-shaped deadeye with five lanyard holes was recovered from concretion. Of particular interest was a boat-shaped, lead ingot which is presumed to have belonged to the ship. It was 32.5 in. (82.5 cm) long and weighed 125.4 lb. (57 kg). Its flat upper surface was stamped with marks resembling a capital T.

Several barrel staves were seen, but only one was recovered. It was 27.7 in. (70.3 cm) long and had been triple-crozed at one end. The other end was blank. Examples of white cooperage were also seen. Remains of two tools were found. One was a concreted saw blade. The other, of wood, is believed to have been a serving mallet. The only navigational item recovered was a 17.2-in.-long (43.7-cm), octagonal sounding lead weighing 16 lb. (7.3 kg). It had been inscribed with the Roman numerals XVI (or XIII).

Of special importance were two disc weights which are also presumed to have been part of the ship's equipment (Davenport and Burns 1995:35; Bound 1995:14). They were made of lead or pewter. They were 2.8 in. (7.0–7.2 cm)

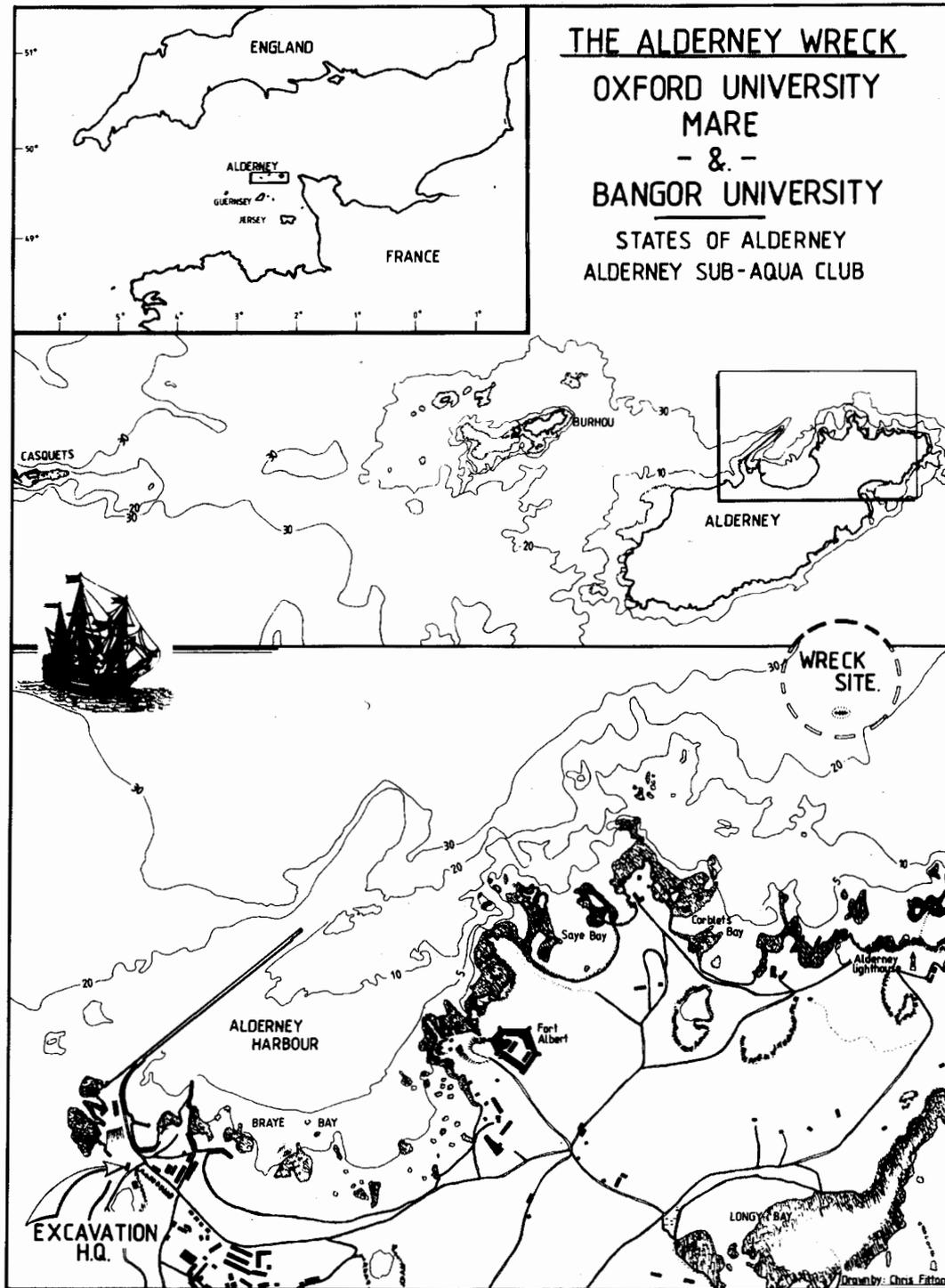


FIGURE 1. Map of Alderney showing the location of the wreck. (Drawing by Chris Fitton.)

in diameter, weighing 1 lb. (0.5 kg), and 3.3–3.4 in. (8.3–8.7 cm), 2 lb. (0.9 kg), respectively. Both weights bore the same verification marks: the Guildhall dagger (the symbol of the City of London) and the crowned royal cipher of Queen Elizabeth I. The crowned EL shows that the weights were from the new avoirdupois standard that was legalized by proclamation in 1587 and remained the primary standard of England until 1824. However, work on the 1587 weight standard was not completed until 1588, the year of the Spanish Armada, which is thus the *terminus post quem* for the wreck.

Artillery

Reports varied according to the state of the constantly mutating sand bank, but there appeared to be a minimum of six to eight iron cannon on the site. Judging from the shot and

the two cannon investigated, all the guns were apparently 3½-in. (8.9-cm) bores. In 1994, one of the concreted cannon and part of its carriage was raised. During the removal of the concretion, the tampion was found in place and shot found in the barrel. The barrel was without any decoration but displayed its weight as 1,400 lb. (636.4 kg) and had a bore of 3⅞ in. (9.0 cm), thus making it a saker (Blackmore 1976:392–396; Caruana 1994:9).

Forty-one pieces of round shot, 10 pieces of starshot, and 5 pieces of barshot were recovered. The round shot was of 3⅞ -in. (7.9-cm) diameter. The starshot consisted of two iron hemispheres cast over an iron bar which drew to a point at each end. The barshot, which were recovered as a single piece of concretion, each consisted of two iron hemispheres on the ends of an iron bar. The diameters of the hemispheres were 3–3⅛ in. (7.6–7.8 cm).

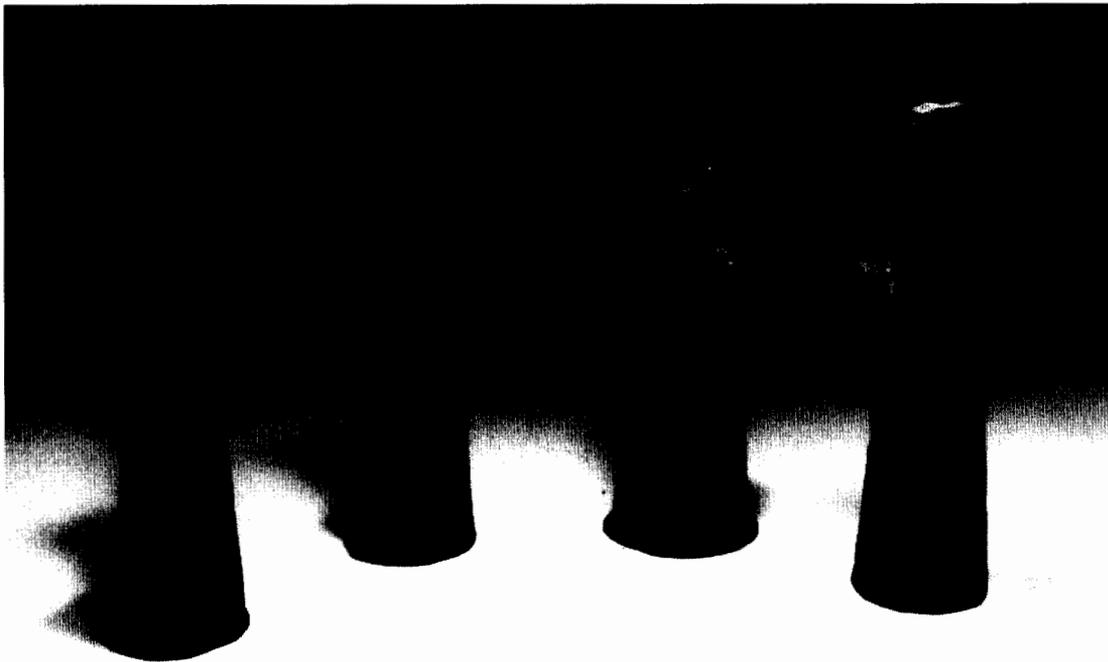


FIGURE 2. *Apostles* were worn across the chest on a bandoleer. Each one contained enough powder for one discharge of a musket. These examples range from 9.9 to 10.6 cm in height and 2.7 to 3.1 cm in lower diameter. (Photo by Paolo Scremin.)

Firearms and Grenades

The large number of shoulder arms that the vessel was carrying has been the cause of some surprise. In this regard, comparisons with the *Mary Rose*, which sank some 50 years earlier, are illuminating. The most prominent weapon on the *Mary Rose* was the longbow; only several muskets were found. On the Alderney ship, by contrast, no longbow remains have been seen. Between the time of the *Mary Rose* and the time of the Alderney ship, the longbow—the quintessential British weapon that decided the great battles of Sluys, Crecy, and Agincourt—was no more. It had been replaced by the musket.

So far, 45 musket fragments have been raised from the Alderney wreck. These consisted of 2 semi-intact stocks and barrels, 26 stock fragments without barrels, 15 barrel fragments, and 2 lock fragments. Most, if not all, have been extracted from concretion. In all cases, the lock mechanisms had disintegrated. From the shape of the lock recesses it was evident that nine of the pieces were from matchlocks and one from a wheel lock. One of the matchlocks, which was much heavier than the others and featured a pintle on the underside of its forestock, had most likely been for shipboard use.

The shape and modeling of the stock were different with each weapon. All the butts were missing, the majority having broken off at or beside the thumb groove. One of the stocks which was apparently older than the others evidently had possessed a steeply dropped butt. It also lacked a thumb groove. However, it featured a broad recess on the underside to take the three outside fingers, leaving the index finger free to work the trigger bar.

Twenty-four *apostles*, or parts of *apostles*, were recovered (Davenport and Burns 1995:33; Bound 1994:26; Bound 1995:12). These *apostles* were small metal canisters, each containing enough gunpowder for one discharge of a musket (Figure 2). The correct amount of powder was crucial for a successful firing. Too much and the barrel might rupture; too little and the ball would lose pace, range, and accuracy. In a

firefight situation, there was not time to pour a precise amount of powder, so premeasured quantities were stored in these little canisters that were then hung from a bandoleer about the chest. Usually there were 12 of them, hence the name *apostle*. All the Alderney examples were made from thin copper alloy sheets, and their seams were closed with a lead-tin solder. Several still smelled of gunpowder.

In addition to the *apostles*, two large, trapezoidal, wooden flasks for priming powder were recovered. So far, only one has been studied in detail. Apart from an oak panel in the base, the body was of one-piece, maplewood construction. Evidence of a leather covering was also found during conservation. Its height was 7.2 in. (18.2 cm), and its base measured 2.0 x 8.9 in. (5.2 x 22.5 cm). One intact ceramic incendiary grenade was recovered (Figure 3) along with an additional 135 fragments which perhaps represented a minimum of 8–12 further examples. They were all globular in form with a well-defined rim over which a fabric cover had been tied and tarred. The light buff or orange clay recalled Beauvaisware.

Bladed Weapons

The remains of a number of bladed weapons were recovered, and more were seen toward the north of the site. Three hilts and 16 grips were raised. The main hilt consisted of no more than a concreted shell in which the cup and the voids of the lower quillon, the knuckleguard, and the rear of a wedge-shaped blade with a ricasso at top could be seen. Sixteen pieces of sword scabbard were also recovered from concretion. The remains of blades inside the scabbards suggested that the majority were double edged. Only one was definitely single edged. The scabbards consisted of two wooden laths covered with leather. In 1995, a complete, sheathed sword was raised.

Armor

Nineteen intact and fragmented helmets were recovered. Three were apparently of burgonet type; seven were apparently of morion type; and

29 November 1592 (Public Record Office [PRO] 1592) and 1 February 1593 (PRO 1593) and had been sent to Elizabeth I's Chief Minister by Sir John Norris, who was commanding an English expeditionary force in Brittany at the time (Wernham 1984). They refer to dispatches that had been sent to him after he had left England on 27 October 1592, but which had been lost off Alderney: "Lastly I must beseech your L: to hasten her Mats resolution and answer to my former letters, wherof I have yet hard nothyng but that toe packets sent from your L: sins my comyng over are lost In a shypp that was cast away about Alderney" (PRO 1592). The second letter, dated 1 February 1593, refers to orders for musters that had not arrived and which Norris assumes were also lost on the ship which sank off Alderney.

In view of the archaeological evidence and the reliable nature of Parham's sources and the historical events to which they allude, it would seem unnecessarily perverse to ignore the likelihood of a common identity between the wreck currently under investigation and the vessel referred to in Norris's letters.

Conclusions

Although to a certain extent circumstantial, the evidence is nonetheless compelling and points to a smallish, nimble, lightly armed vessel of little offensive capability that was likely of English origin but not a Queen's ship. At the time of its loss from natural causes in 1592, the ship was acting as a dispatch carrier and military transport in support of Norris's expeditionary force in France.

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Pipe Dreams: Consumerism, Smoking, and the Clay Tobacco Pipe Collection from Port Royal, Jamaica, 1692

Introduction

Anthropologist Sidney Mintz notes that the first cup of sweetened hot tea drunk by an English worker was a significant historical event. Commodities like tea, tobacco, and sugar “pre-figured the transformation of an entire society, a total remaking of its economic and social basis” (Mintz 1985:214). In adopting a new commodity, a society not only adjusts to the external impact this commodity brings about, but internalizes such change by integrating “newly acquired behaviors into daily or weekly practice” (Mintz 1996:20).

The aim of this paper is to understand how one commodity, tobacco, reflects social change in colonial British America, particularly at Port Royal, Jamaica. Because of its geographic location and function as a port city, Port Royal provides an outstanding example of the impact of new commodities on social change. The study of tobacco consumption in British America also provides the ideal vehicle for this task because unlike other commodities such as sugar and cloth, tobacco crossed all social boundaries very quickly. In fact, it can be argued that tobacco consumption signaled the beginning of a new consumerism that largely preceded the Industrial Revolution.

In the desire for tobacco, a new material culture arose through the use of clay tobacco smoking pipes. As artifacts, clay pipes reflect historical trends because they are instructive in understanding the balance between the value and meaning of objects in a society. Clay pipes, like other commodities, reflect the culture that used, purchased, and discarded them. They were also the first disposable commodity. Although clay pipes are represented in written accounts and the

visual arts, a study of the archaeological record of clay pipes recovered at Port Royal provides a window into 17th-century English society—a society that was changing politically, economically, and socially both at home and abroad.

Port Cities and Early Consumerism

Critical in understanding the relationship between such change and the emerging consumerism is the expansion of London and other port towns in what Peter Borsary (1989:viii) calls an urban renaissance. As market centers, port towns served as major entrepôts for trade and the distribution of goods. In this regard, Port Royal was no exception. From the early 1660s until the 1692 earthquake, Port Royal served as the main entrepot for Jamaica. Nuala Zahedieh (1986:220) estimates that by 1680, 150–200 vessels a year were clearing Port Royal’s harbor.

As Britain’s busiest port city in the English Caribbean, Port Royal was highly diverse both in terms of population and activities. The merchants of Port Royal not only initiated and encouraged active commerce, but their presence also guaranteed that a wide range of goods were imported to satisfy basic needs as well as to serve as a reminder of the homeland. Maritime ports like Port Royal not only mimicked their larger counterparts like London, they epitomized a consumer society on a smaller but no less significant scale.

After 1672, Port Royal became known as the “storehouse of the West Indies” and typified the characteristics of what one 17th-century observer called a “continual Mart or Fair, where all sorts of choice Merchandizes are daily imported” (Hanson 1683). With the accumulation of wealth in Port Royal, money was “spent on the spot,” thus fueling fervent merchant activity and the demand for imported goods (Davis 1962:274).

Both probate inventories (Thornton 1991, 1992) and the archaeological evidence at Port Royal indicate a site profusely rich in consumer goods. Crystal drinking glasses, pewter plates, tankards and cutlery, Chinese porcelain, silver objects, and fine ceramics all testify to the demand of 17th-century consumers in the colonial

port city. Because sea captains and merchants in Port Royal had direct access to a variety of consumer goods from Asia, Africa, and Europe, they may have provided the source for innovative consumer behavior, as Steven Pendery (1992:64) has suggested for the Massachusetts Bay Colony.

Chief among the archaeological finds at Port Royal are the remains of clay smoking pipes, including whole pipes and stem and bowl fragments. By the time the Penn and Venables expedition had captured Jamaica from the Spanish in 1655, pipe smoking as a social pastime was well under way in England and Europe. By the time of the 1692 earthquake, Port Royal had witnessed nearly 37 years of tobacco smoking by its own citizens.

Tobacco Consumption in English Society

Both at home and abroad, the British adopted tobacco smoking with a zeal that fueled a whole new industry in the planting and trading of tobacco. In 1615, approximately 50,000 lb. of tobacco were imported to England from the American colonies. By 1700, tobacco imports had increased to 38 million lb., 13 million of which were consumed at home. The remaining amount was re-exported to Europe and other markets (Wilson 1984:169).

What accounts for this consumption and the popularity of tobacco smoking? There are a number of reasons including medicinal use, tobacco addiction, and alleviation of hunger, but the most compelling argument is that tobacco smoking served as a pleasurable social pastime, complete with its own rituals and material culture. Herein lies one possible explanation for the mass appeal of smoking in the 17th century: through its rituals and aesthetics, smoking offered a "magic insubstantiality" (Laqueur 1995:45). In a Durkheimian sense, pipe smoking was a small, sacred act in the ordinariness of everyday life.

In another sense, smoking provided a coping mechanism for a society undergoing transition. With the exception of cities like London, English society remained an amalgam of small-scale communities where family and neighborly coop-

eration were still emphasized. Yet, English society was experiencing new social alignments, changing economic conditions, and shifting demographics (Reay 1985:18; Wrightson 1982:13-14). The introduction of tobacco was therefore timely because tobacco offered "a paradoxical experience . . . with its contradictory physical effects, its poisonous taste and unpleasant pleasure." It thus served "as a drug for easing the anxiety arising from the shock of successive assaults on old certainties and the prospect of greater unknowns" (Klein 1993:27).

Smoking also encouraged conviviality and conversation among various social groups, interaction that helped foster a greater sense of well-being. Jürgen Habermass (1989:25) maintains that the transformation of English culture developed in the public sphere, which was embodied in institutions such as coffeehouses, taverns, and clubs, where all members of society were embraced and where the private domestic world of conversation could be legitimized and serve as a means of moral instruction, thus shaping attitudes and manners. According to David Conroy (1995:6), taverns in colonial British America promoted social relations and community cohesiveness. Although people probably smoked in their homes, it is in the social worlds of the alehouse and tavern where smoking mostly occurred, along with eating and drinking.

Port Royal and Clay Tobacco Pipes

That the social worlds of the alehouse and tavern played an important role in English society is substantiated at Port Royal, which was well-known for its taverns and alehouses. By 1670, the number of drinking establishments had reportedly doubled, prompting one observer to note that "there is not now resident upon this place ten men to every house that selleth strong liquors" (Burns 1954:329).

Because of the common link between drinking, smoking, and taverns, it seems likely that tobacco pipes would be found in the context of Port Royal's taverns and tippling houses as well as the merchant storehouses that supplied these places. Probate inventories add little in this re-

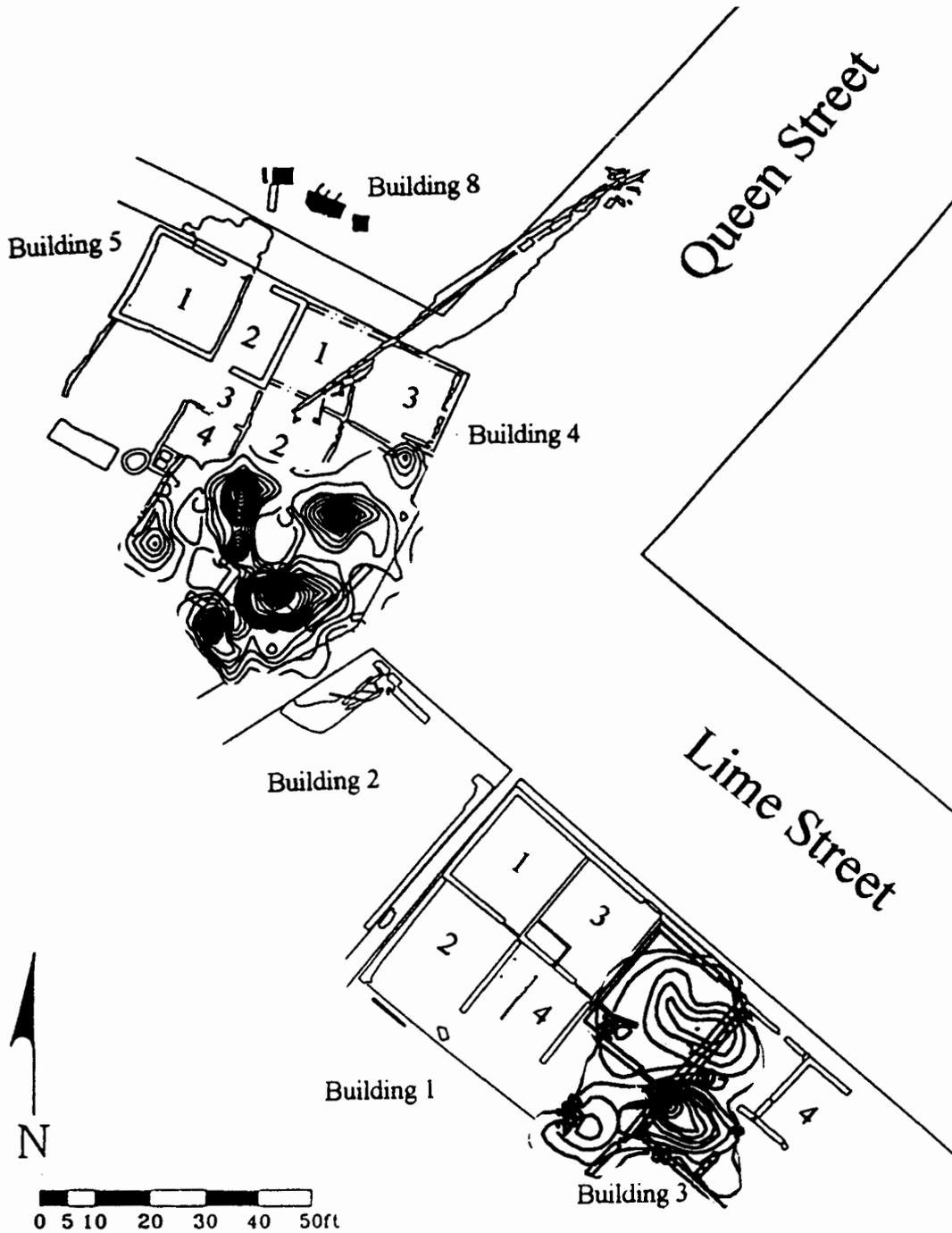


FIGURE 1. Concentrations of kaolin clay pipes from the 1981–1990 excavations of Port Royal, Jamaica.

gard. For example, in one of the few inventories that mention pipes, 10 gross of pipes are listed for the merchant John Tull (Thornton 1992:78).

The archaeological record tells a different story, however. Over 18,000 clay smoking pipes have been found on the site, both whole and in fragments, smoked and unsmoked. Most of the Port Royal clay pipes were produced and shipped from Bristol, England, and include almost 200 pipes with makers' marks. Some of the makers' marks include LE (Lewellin Evans), WE (Williams Evans), and RT (Robert Tippet family).

Excavations conducted by D. L. Hamilton from 1981 to 1990 concentrated at the heart of the commercial center, on Lime Street near the intersection of Queen and High Streets (Figure 1). Many of the site's clay pipes were found in Building 1, a well-constructed brick building consisting of six ground-floor rooms that were divided into three separate, two-room combinations facing Lime Street. According to Hamilton (1985:108, 1992:44), Rooms 5 and 6 of Building 1 were most likely a wine and pipe shop combination. That over 2,000 new, unsmoked pipes were discovered in Room 5 of Building 1—along with numerous onion bottles, a few candlesticks, and other objects associated with smoking and drinking—strongly supports this interpretation.

Room 4 of Building 1 may have been a tavern. The contents of this room were protected and preserved by a fallen wall from the earthquake. Artifacts found between the fallen wall and brick floor included numerous wine bottles, a crushed wooden table, and a stool.

Built on a mortar foundation and of timber-frame construction, Room 2 of Building 3 included a large number of unsmoked, new pipes found lying alternately end-to-end, possibly indicating how they were packed and stored. A number of uncorked onion bottles were also recovered, suggesting that Room 2 served as storage areas for these items (D. L. Hamilton 1996, pers. comm.).

Three hundred sixty-five clay pipes, 18 of which were whole pipes, were also found in the structure designated as Building 5 (Hartmann

1991:33). The remains of animal bone, cookingware, wine bottles, and pewter suggest that Building 5 functioned as a tavern that served food. Although not yet plotted on Figure 1, the pipe remains were concentrated in Room 2 and Yard 5.

Familiar Customs in a New Land

What does this evidence reveal about pipe smoking in Port Royal, and how does it relate to the emerging consumerism in 17th-century British society? Firstly, tobacco smoking was as popular in Port Royal as it was in England. Secondly, the evidence suggests that British America was, in some ways, a mirror image of English society at home. Despite regional differences and distinctive place-specific and time-specific experiences in British America, English colonists, in general, possessed an awareness of a shared culture that contributed to their commonality. This awareness allowed them to maintain age-old institutions and customs in new settings.

As colonists developed their own societies, their demands for material goods helped reaffirm English ways in a foreign setting but also allowed them to form new identities. As a result, the material expectations of the English colonists created what Richard Dunn (1972:45) calls "a hectic mode of life that had no counterpart at home or elsewhere in English experience." This statement was true for Port Royal, where in an unfamiliar tropical environment, goods helped define expectations for a newly evolving society of merchants and planters.

Conclusion

The desire for tobacco fueled the trade of a new commodity that greatly affected Britain's economy and society. As artifacts, clay pipes reflect these fundamental developments. James Gibb (1996:5) describes European colonists as acquisitive in their desire to create a world where they could live comfortably, both in a physical and ideological sense. As a port town in the midst of a thriving economy and chang

ing social order, Port Royal was both a testing ground and a model for emerging consumerism and acquisitive behavior. Here new ideas and interactions flourished, and in an unrestrained atmosphere, varying methods of communication could be accepted or rejected.

Ultimately, the ubiquitous clay pipe reveals a story about cultural change. Clay pipes are more than merely objects from which tobacco was smoked. Clay pipes remind us of a time of new beginnings for a society and culture that was on the threshold of great change. As consumer goods, clay pipes were the “key instruments for the reproduction, representation and manipulation of [a] culture” (McCracken 1990:xi). For the archaeologist, they help open the door to understanding that culture.

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Bozburun Byzantine Shipwreck Excavation: Preliminary Results from the 1996 Season

The Bozburun shipwreck is located off the southwest coast of Turkey, near the village of Selimiye, on the north side of the Bozburun (or Hisarönü) Peninsula. The wreck was initially identified and surveyed in 1973 by an Institute of Nautical Archaeology (INA) team led by George Bass, based on information provided by Mehmet Aşkın, a local sponge diver (Bass 1974, 1975). Subsequent visits in 1982, 1992, and 1994 were made to monitor the site and to investigate the extent of preservation of hull remains. Excavation began in 1995.

The site was dated to the 9th or 10th century A.D. by a single amphora recovered during the initial survey. Of at least 1,200 known Mediterranean shipwreck sites dating before A.D. 1500, barely a dozen are dated to the last quarter of the first millennium A.D. (Parker 1992:15), and only two medieval wrecks have been excavated completely, the 7th-century *Yassıada* and 11th-century *Serçe Limanı* wrecks. The Bozburun ship was chosen for excavation because it offered an excellent opportunity to examine developments in economy, resource usage, and maritime enterprise in a period when the eastern Mediterranean was in the midst of drastic political and economic realignment. It was also hoped that well-preserved hull remains would help illuminate some of the technical and conceptual aspects of the development of shipbuilding.

The Site

The wreck lies almost directly beneath the cliffs of Küçüven Burnu, just to the west of the mouth of the Selimiye harbor. The cliff face is nearly vertical, descending 25 m to the sloping, sandy bottom. The most visible aspect of the site is an amphora mound approximately 20 m long

and 8 m wide, with one end (probably the stern) lying against the base of the cliff and the other directly down slope, at a depth of 36 m. The site is covered with debris, the result of 11 centuries of falling rocks and dragging anchors, as well as the wreck event itself. Wreck material, including a concreted, cruciform anchor, is also scattered in the rocky ledges just above the amphora mound, and a few amphoras have rolled down to where the bottom levels out, more than 60 m below the surface. The bottom sediment is primarily loose sand covering a denser layer of compacted sand, with some organic components. The wreck has acted as a trap for the finer components of winter runoff and decomposed organic matter from the ship so much of the wreck material is embedded in mud.

The Excavation

The 1995 season, with only 5 weeks of diving, was largely taken up with the establishment of working facilities, preliminary mapping of the site, and removal of some of the broken and tumbled material in the upper layers. The 1996 season, lasting 12 weeks, was devoted to more thorough excavation of the upper (stern) half of the site, with some exploratory work in the lower units. In addition to removing more of the broken material that covers most of the site, a staff of 30 was able to recover 142 whole or nearly whole amphoras (Figure 1), an even larger number of partial amphoras and the small finds associated with them. In removing these amphoras—almost all of them from the upper layer of cargo, which has rolled and tumbled out of place—the staff exposed the intact parts of the site. The lowest layer of the cargo proved to be relatively undisturbed, and the original stacking pattern was easily observable. In one unit, near the center of the mound, removal of the upper layer of amphoras revealed an area of the ship's hull. All of the recovered material, except for approximately 600 kg of coarse plainware shards redeposited on-site, was transported to the Bodrum Museum of Underwater Archaeology for conservation and curation.

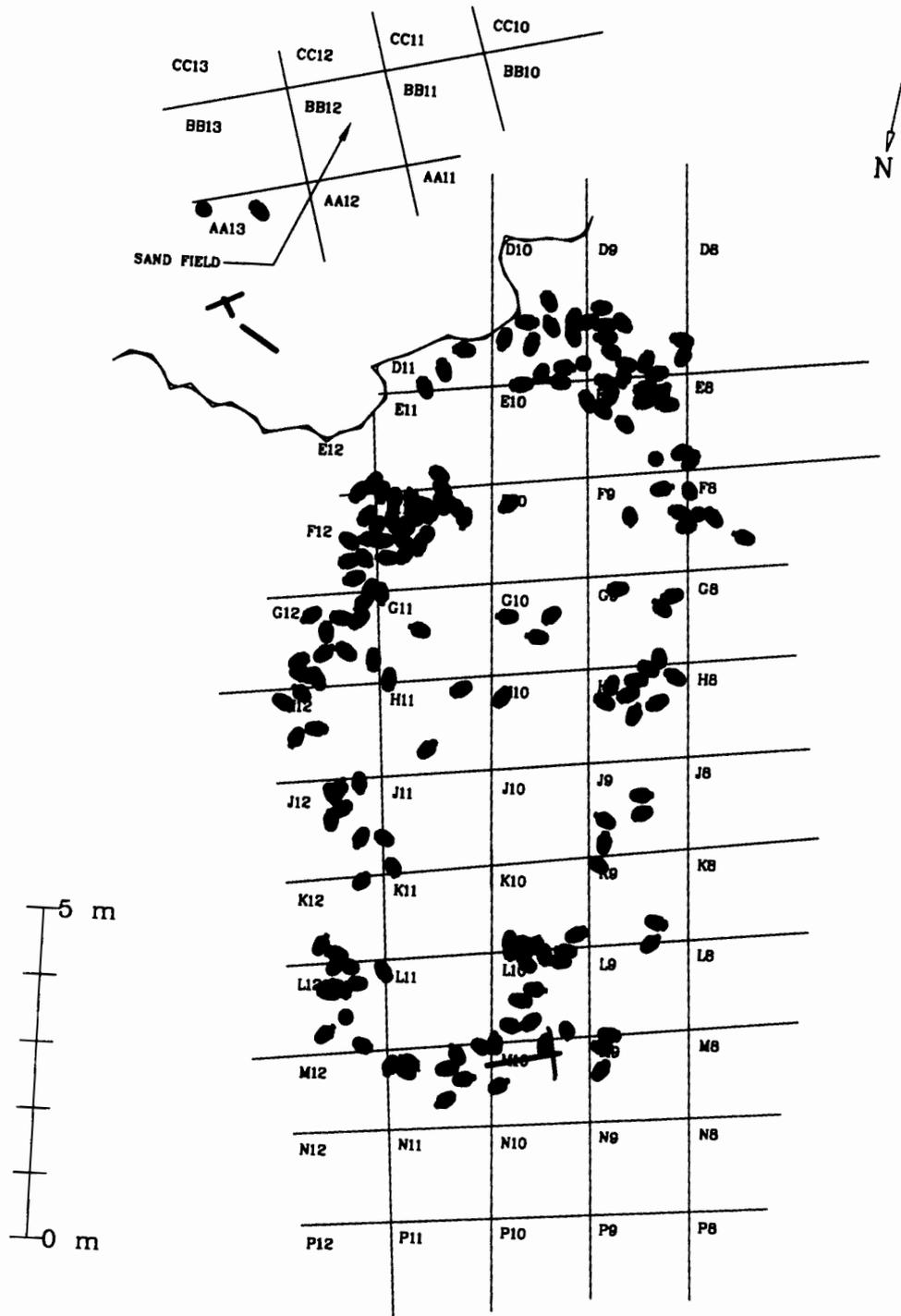


FIGURE 1. Bozburun shipwreck site, showing grid arrangement and whole amphoras raised in 1995 and 1996. The shallow (stern) end of the site is at the top of the figure. The sand field in upper left (southeast) is a ledge at the base of the cliff, approximately 2 m above the main amphora mound. (Drawing by M. P. Scafuri.)

The Finds

Amphoras

The amphora mound, the remains of the primary cargo, comprises the most visible and extensive part of the site. Current estimates put the original number of amphoras between 1,500 and 2,000. Many of these are now broken, and a number (perhaps 100–200) had been removed by sponge divers and other visitors before excavation began. Two, and perhaps three, classes of amphoras can be identified among the recovered jars. As no definitive typology for middle Byzantine amphoras has yet gained wide acceptance, the classification presented below is a working typology only.

Class 1 amphoras, by far the most numerous, range between 40 and 45 cm in height and are ovoid in shape, with a rounded base, short neck, heavy rim, and slight to distinct wheel ridging (Figure 2, left). The handles are approximately L-shaped, elliptical in section, and attached just below the rim and on the shoulder. Capacity is approximately 13 liters. The best parallels for these amphoras come from kiln sites in the Crimea, although fabric analysis remains to be done to confirm this relationship (Yakobsen 1970; Garver 1993:120–129). These sites are dated to the 9th and early 10th centuries, although examples of similar jars, almost all fragmentary, from sites in Constantinople are occasionally dated slightly later (Hayes 1992:73–75).

Class 2 jars are much less common than those of *Class 1*, but they are evenly distributed within the cargo. Only two have been recovered and another three identified on-site. They are shorter, ranging in height between 36 and 40 cm, with squatter bodies, a flat or kicked up base, and a much wider neck and mouth (Figure 2, right). No particularly close parallels for these peculiar little amphoras have yet been identified, although broadly similar jars were produced in the Constantinople region in later centuries.

A *Class 3* may exist, although its identification is still debated by the project staff as it bears many similarities to *Class 1*. The distinguishing features are rounder handles and a

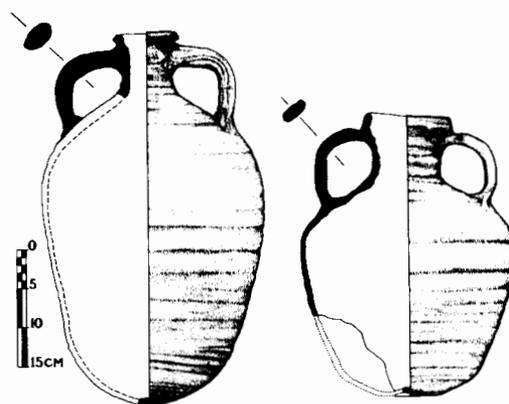


FIGURE 2. Representative amphoras from the Bozburun shipwreck: left, Class 1; right, Class 2. (Drawings by S. Oğuz.)

taller, straighter neck without the heavy, rolled rim. The recovered examples are also larger than the *Class 1* amphoras, ranging in height from 47 to 51 cm. Extremely close parallels from Crimean kiln sites date to the 8th and 9th centuries (Yakobsen 1970:40; Garver 1993:123, 126).

The attribution of any of these amphoras to specific kiln sites is tentative as insufficient work has been done on amphora production centers outside of the Balkans and the Crimea. At least one Italian kiln of the early 9th century was producing very similar jars (Arthur 1989), and amphoras of this basic ovoid type are widely known from middle Byzantine contexts. In addition, there is ample evidence from both before and after this period that amphoras were reused as transport containers, sometimes extensively (Van Doorninck 1989), so the origin of the containers may have no direct relationship to the origin of the cargo. There is as yet no clear evidence that the Bozburun amphoras were reused, but only a small sample has been recovered.

Analysis of the contents of the amphoras, some of which still have wooden or ceramic stoppers sealed in place with pitch, indicates that the primary cargo was wine, although probably not of very high quality. Nearly all of the intact amphoras recovered thus far have produced

grape pips, and one held more than 400 seeds. One amphora was full of olives, but this find is from the stern and may represent provisions rather than cargo. Many of the amphoras are marked with graffiti, probably indicating ownership. Two full names can be found, Nicetas and Leon, as well as a range of abbreviations, Christograms, and symbols that may be tally marks. At least two jars are marked $\epsilon\pi\iota\varsigma$, which may be an abbreviation for the Greek word for *bishop*, suggesting a Church connection.

Domestic Coarsewares

Four nearly complete coarseware pitchers, all of different sizes, shapes, and fabrics, have been recovered to date. All come from the stern and were probably for use onboard ship. Large sets of pitchers have been found on both the Yassıada and Serçe Limanı ships in contexts indicating that they were part of the ships' inventories (Bass and Van Doorninck 1982:168–172). The forms of these pitchers are common among the domestic potteries of the eastern Mediterranean (Hayes 1992:32) and very difficult to trace to any particular region, although one pitcher carries an incised, wavy line similar to decoration found on a contemporary pitcher of the same basic form from northern Iran (Morgan and Leatherby 1987:94–96, Figure 53, no. 7). In addition to the pitchers, fragments of bowls, plates, and cooking pots have also been found in the stern near the possible remains of a stone-tiled hearth.

Other Small Finds

One of the more surprising finds in 1996 was a small goblet of blue-green glass. Although two nonjoining pieces were recovered, the shape can be reconstructed. A round, flat base and short stem support a deep, flat-bottomed body tapering toward the flaring, slightly rolled rim. Stemware is a rarity on Mediterranean shipwrecks, but this piece may be the personal possession of a member of the crew or a passenger. The vessel type, which is sometimes described as a lamp, is com-

mon in nonmaritime contexts from the Roman and Byzantine worlds. A fragmentary copper jug is sufficiently well preserved to allow recognition of the common Byzantine form. A similar jug was recovered from the 7th-century Yassıada wreck, where it was probably part of the ship's tableware (Bass and van Doorninck 1982:269–270, MF 5).

Other finds include lead fishnet and line sinkers, probably intrusive, and a large number of concretions, mostly of fasteners. A few tools can be identified, including what are probably a double-headed felling ax and a smaller ax or hatchet. Such tools are relatively common finds on Mediterranean shipwrecks and are only a small part of the assemblage of carpentry and foraging implements to be expected onboard a ship.

The Hull

An area of approximately 2 m² of hull remains was exposed, probably forward of amidships (Figure 3). Although the amount of structure examined was relatively small, it did include the keel (with a scarf), four frames, three strakes



FIGURE 3. Bozburun shipwreck hull remains exposed in 1996, looking up slope or aft (south). The three transverse timbers (FR 50–52) are frames; the longitudinal timber on top of them is a stringer approximately 0.45 m to starboard of the keel. Part of the intact cargo is visible at upper left. (Photo by D. A. Frey, INA.)

from the starboard side, one strake from the port side, a heavy stringer, fragments of two ceiling strakes, and the extremely fragmentary remains of what may have been a keelson (Figure 4). Except for the keelson and one of the ceiling strakes, these remains are all in excellent condition for a Mediterranean wreck, with crisp edges, tool marks, and relatively little teredo infestation. The timbers are all fastened together with iron nails and bolts, and there is no sign of mortise-and-tenon joints—although none are expected in a ship of this date. The keel and planking are of white oak (*Quercus* sp.—probably *Q. ilex* or holm oak, the only large white oak growing in quantity in the Mediterranean or Black Sea basin). The frames, stringer, and ceiling are of pine (*Pinus* sp.). This choice of materials is a little surprising as other archaeological evidence suggests that oak was not commonly used for structural timbers in Mediterranean ships before the late Middle Ages and that hardwoods in general were preferred by Mediterranean shipwrights for frames. Softwoods, particularly pine and larch (*Larix*), were more commonly used for planking. The range of *Q. ilex* is not necessarily extensive, with the largest stands along the Adriatic and western Mediterranean shores, although it also grows well around the western and southern Black Sea (Atalay 1983; Polunin and Walters 1985). More accurate identification of the pine used in the ship may help identify a likely origin for the ship, as may dendrochronological analysis currently under way.

Preliminary Conclusions

Some time in the 9th or early 10th century, a merchant vessel between 15 and 20 m long came to grief on the rocky shore of southwestern Anatolia. Its primary cargo of wine was probably not of local origin, as walking surveys of the nearby countryside have confirmed that the terracing of the hillsides would not have favored viticulture, but rather the cultivation of wheat or olives, both of which are still grown in quantity in the region. It is likely that the ship was bound for Selimiye (then known as Hyda or Hyla) or passing the entrance to the harbor when

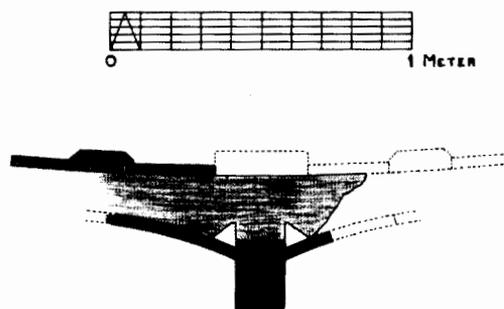


FIGURE 4. Schematic section through Bozburun hull remains. Solid lines represent surviving elements. (Drawing by F. M. Hocker.)

it was lost. Winds are usually out of the north to northwest during the sailing season but can veer rapidly into the northeast early in the season. This wind shift could easily push a ship entering the harbor toward the rocks, although it would still be relatively easy to turn away and run down the channel back toward the Aegean. Therefore, an additional factor is probably involved.

Although the site of the wreck is not on any major sailing routes but is well up into a deep bay, it is near the entrances to three of the larger medieval settlement areas on the peninsula. All were considered worthy of defense in the troubled times of middle and late Byzantine administration before the southwestern coast was overrun by the Turks in the 13th century. Selimiye boasts a castle above the town, as do the other two harbors of Bozburun village to the south and Orhaniye to the north. The ship may have been carrying wine to supply one of the garrisons or to trade, or it may have been driven into the shelter of the bay by weather or pirates. For most of the 9th century, the strait between Crete and the Anatolian mainland was threatened by Moslem pirates based on Crete. One of the major north-south routes of the period, connecting Rhodes and Constantinople, passed just to the west, at the mouth of the bay.

The origin of the ship and its cargo cannot yet be determined with any certainty. If the amphoras were only used once, a Crimean origin for a cargo this far south is not out of the question.

The eastern Crimea, then in Byzantine hands, was well connected with the Mediterranean as an accessible source for the valuable products of the Far East and the Russian steppes, and the Black Sea was an integral part of the Byzantine maritime world. Goods from all over the Empire were collected and redistributed from Constantinople, so a Crimean cargo could easily find its way farther south. There is some suggestion in the galley pottery that the ship was widely traveled, although the ubiquity of the coarsewares and the simplicity of the decoration hardly inspires much confidence in this assumption. Due to the restricted range of the oak, the timber used in the ship may provide some help in tracing its origin. A Black Sea timber connection is possible, although an Italian or Dalmatian origin is just as plausible.

Work in 1997 will concentrate on recovery of the lower layer of stacked amphoras, exposure of a larger area of hull remains, and commencement of large-scale work in the lower parts of the site. Field walking of the surrounding area will continue in an attempt to define the contemporary maritime cultural landscape. It is hoped that two more seasons will see completion of the excavation phase, which may include recovery of the hull remains for more detailed study and conservation.

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Metrological Aspects Reflected in Early Medieval Shipbuilding from the Southern Baltic Sea

Introduction

As a result of more than a century of research in the Baltic region, a relatively large number of shipwrecks and ship-related artifacts are available today for detailed analysis and interpretation. This material proves to be an indispensable source of knowledge, especially for the early medieval period when historical and iconographic sources relating to shipbuilding and seafaring are scarce or contain biased information.

A special situation is presented by the finds from the Southern Baltic region, specifically those located along the coastline stretching from the base of the Jutland peninsula in the west to the Vistula lagoon in the east. The archaeological material uncovered at several sites from this region consists of about 30 shipwrecks and derelicts representing keeled vessels, several dug-outs, and numerous isolated ship-related fragments. The following analysis focuses on early medieval keeled vessels inasmuch as they incorporate some of the highest technological achievements of that period. Two main aspects are taken into consideration: the first concentrates upon dimensional variability of principal hull members, while the second underlines proportions between different timbers in the same hull and/or between timbers of the same class but from different hulls. The conclusion concentrates on the existence of a certain measurement system used in Southern Baltic shipbuilding. A short comparison with other measurement systems used in the Baltic region during the Middle Ages tries to ascertain the degree of originality or similarity between the two elements of comparison.

Dimensional variability in hulls of different sizes was assessed only on timbers similar in shape and function. Thus, the target range limited itself from the beginning to keels, planks, and floor timbers. The small number of other timbers with possible similar shapes such as posts, beams, stringers, knees, breast-hooks, deemed inadequate their inclusion in a workable sample size. The information on the aforementioned hull members appears sufficient to present the data at the univariate level of exploratory data analysis, the level in which the rank ordering of dimensional attributes enables us to understand better the differences between timbers from the same class.

Keels

As mentioned before, all finds analyzed were remnants of keeled vessels. All keels were carved out of a single trunk of wood, and almost all of them (with the exception of the Szczecin keel-plank) display a characteristic T-shape. If the total molded dimension obtained for Southern Baltic keels is arranged in a linear progression, we find that the values fall at intervals of 0.5 cm in all but one case and fall within a total range of only 4.5 cm (Table 1a). This range indicates a minimal difference between these molded dimensions.

The display of the same data in a resistant summary reveals that the median point is at 11.75 cm, while the bottom quartile and the upper quartile are to be found at 10.5 and 12.5 cm respectively (Table 2a). The third row indicates that the lowspread is smaller than the highspread value ($1.75 \neq 2.75$), while the second row shows that the distance between the median and the lower quartile is higher than the distance between the median and the upper quartile ($1.25 \neq 0.75$). Furthermore, the distance between the lower extreme value (10) and the lower quartile

is 0.5 cm, while the distance between the upper extreme value (14.5) and the upper quartile is 2 cm. These comparisons show that none of the conditions of equality are satisfied for a normal distribution about the median 11.75. On the contrary, the values seem to concentrate at the lower quartile and in between the median and the upper quartile. A stem-and-leaf display of the same data confirms that what appears to be a normal distribution is actually a bimodal distribution which is negatively skewed: this distribution means that keels tend to have molded dimensions concentrated either at the 10 or the 12 value and in between these values (Table 3a).

The apparent conclusion obtained earlier by arranging the data in a linear progression confirms that keels have minimal differences in the molded dimension. This impression can be visualized better if a so-called *Tukey line* is fitted onto the scatter plot (Figure 1). As it can be seen, with the exception of three finds (Szczecin,

Mechlinki, and Ralswiek 4), the values revolve around the line of fit which passes through the 11.75 cm median value. This affinity means that the molded values obtained for the Southern Baltic keels tend toward a linear progression related neither to the vessel size nor to their geographic location. In addition, the superficial line inclination suggests a neutral relationship between the length of the vessel and the molded dimension.

A similar progression for the sided dimension (Table 1b), given here as the sum of the widths of both flanges and web, reveals that with the exception of the Frombork shallow keel (49 cm), the values fall at intervals of 5 cm or less within a total range of 21.5 cm. However, the display of the same data in resistant statistics form reveals that keels vary more in the sided than in the molded dimension (Table 2b). The resistant summary gives 21.5 as the median point, 20 as the lower quartile, and 28.5 as the upper

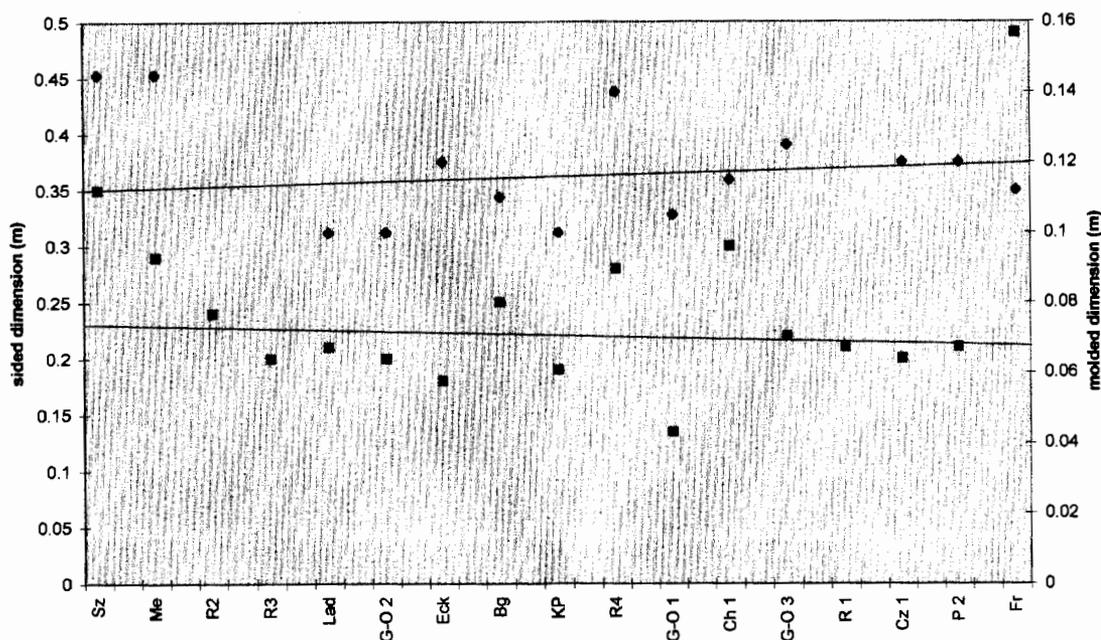


FIGURE 1. Distribution of molded (rhomboidal points) and sided (square points) values for keels of Southern Baltic ship finds. Initials on the X-axis represent names of ship finds: Szczecin (Sz), Mechlinki (Me), Ralswiek 2 (R2), Ralswiek 3 (R3), Lad (Lad), Gdańsk-Orunia 2 (G-O 2), Eckernförder (Eck), Bągart (Bg), Kamień Pomorski (KP), Ralswiek 4 (R4), Gdańsk-Orunia 1 (G-O 1), Charbrów 1 (Ch 1), Gdańsk-Orunia 3 (G-O 3), Ralswiek 1 (R1), Czarnowsko 1 (Cz 1), Puck 2 (P 2), Frombork (Fr).

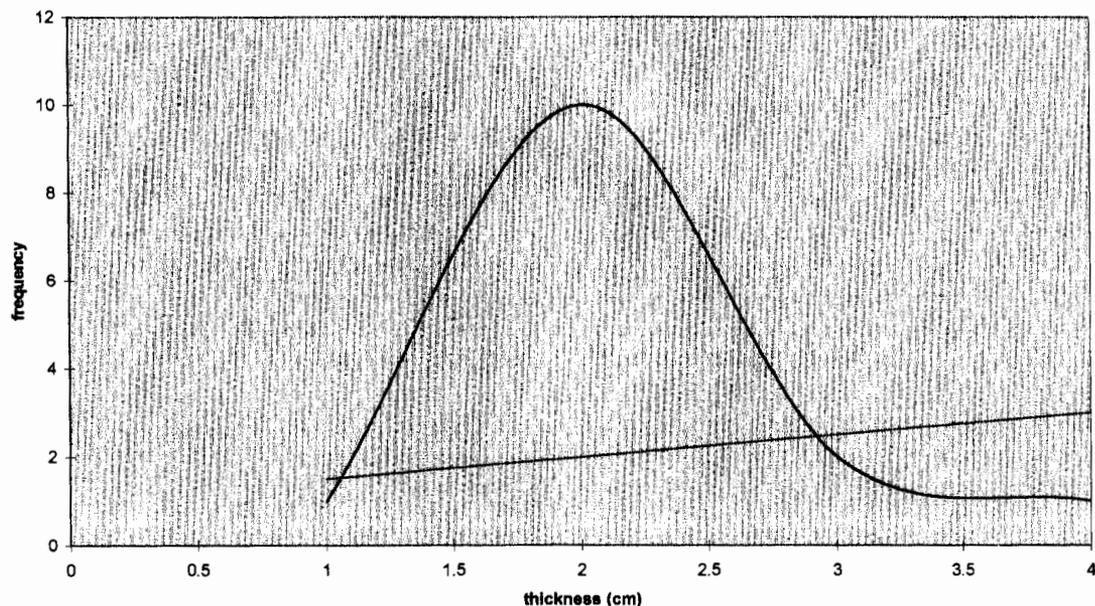


FIGURE 2. Normal distribution of thickness values for ship planks in the Southern Baltic.

quartile, and it shows that none of the conditions of equality are fulfilled. The highspread (27.5) is more than three times the value of the lowspread (8). Compared with the distance between the median and the upper quartile, the median is minimally distanced from the lower quartile. Finally, the difference between the lower quartile (20) and the lower extreme value (13.5) is only a third of the distance between the upper quartile (28.5) and the upper extreme value (49). Thus, with the exception of a cluster located in between the median and the lower quartile, the keel widths seem uniformly distributed along the 13.5–49 range. The same result is obtained by displaying the data in a stem-and-leaf distribution (Table 3b). With the exception of two values (20 and 21), the distribution seems to be uniform. The spread may be the result more of the small sample size than the actual tendency of the data. Nonetheless, the uniform distribution within this sample size seems to suggest a certain degree of homogeneity. If a *Tukey line* is fitted onto the scatter plot, a tendency to fit can be perceived for most of the sided values (Figure 1). The line inclination seems to suggest, as in the case of the molded dimension values, a neutral relation-

ship between the sided dimension and the size of Southern Baltic vessels. This neutrality in both molded and sided dimensions is surprising for ships which differ as much as 9.11 m in the reconstructed length and more than 1 m in breadth. In addition, no relationship can be established between the sided values and the geographic location of the vessels. The ordering of keels into regional clusters does not indicate intraclass distinctions. This lack of differentiation is shown by the random values obtained within each group for the molded and sided dimensions and by the presence of identical or similar values in different groups. It seems that within this sample size, keels do not have a dimensional distribution related to their geographic locations.

Planks

Measurements of planks used in the hulls of most finds enables us to perceive the degree of linearity of principal attributes such as plank width and thickness. The rank ordering of width values, however, can be easily biased if maximum width of planks is taken into account. Since the width of planks can vary with as

much as half its maximum value in the same hull, the best alternative is to use the average plank widths measured for each vessel. As can be seen in Table 1c, in most cases the difference is almost negligible (0.5 cm) within a small range of 2.5 cm (21.5–24 cm). The resistant summary shows that the median is located at 22.5 cm, which situates the lower and the upper hinge at 22 cm and 24 cm, respectively (Table 2c). Since the midsread (22–24 cm), situated between the hinges, is almost identical with the range of slightly differentiated values (21.5–24 cm), the impression is one of a smooth and minimally distanced middle distribution. This impression is strengthened also by the nature of the entire distribution: the low- and the highspread are equivalent ($3.5 \cong 4$), while the hinges are located at about the same distance ($3 \cong 2.5$) from the extremes. These figures would satisfy two of the conditions of equality for a normal, bell-shaped distribution about the 22.5 cm median. However, the fact that the distance between the median and the upper hinge is three times more than the distance between the median and the lower hinge ($0.5 \neq 1.5$) is a clear indication that the distribution is negatively skewed. The conclusion, then, appears to be that planks

were on the average between 22 and 24 cm wide regardless of the size of the vessel or its geographic location.

The rank ordering of planks according to their thickness shows even a greater measure of central tendency. The large number of 2-cm values, coupled with the low variability of the total range of thickness values, produces a distribution heavily centered on the 2-cm value (Figure 2). The resistant summary further indicates that the median and the hinges are both located at the 2-cm value and that all conditions of equality are satisfied for a normal distribution ($0.5 \cong 1$; $0 = 0$; $0.5 \cong 1$) about the median 2. This result indicates that, regardless of individual location, the vessels discovered in the Southern Baltic region were built with planks about 2 cm thick. Most surprising is the fact that no relationship seems to exist between the size of the vessel and the thickness of planking.

Floor Timbers

Each of these ships had hulls reinforced by floor timbers. If their molded and sided dimensions are plotted according to the length of the vessel, the result shows that floor timbers vary

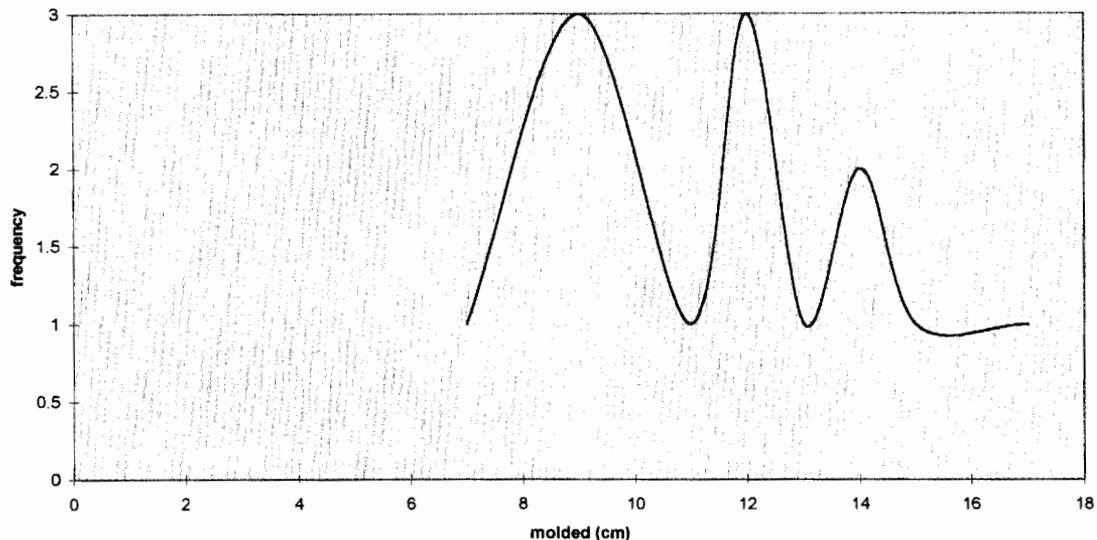


FIGURE 3. Multiple-peak distribution for molded values of floor timbers in the Southern Baltic.

TABLE 1
LINEAR PROGRESSION OF PRINCIPAL DIMENSIONS

<i>a) Keel, molded</i>													
10(3)	10.5	11(2)	11.5	12(3)	12.5	14	14.5(2)						
	0.5	0.5	0.5	0.5	0.5	1.5	0.5						
<i>b) Keel, sided</i>													
13.5	18	19	20(2)	21(3)	22	24	25	28	29	30	35	49	
	4.5	1	1	1	1	2	1	3	1	1	5	14	
<i>c) Planks, average width</i>													
19	20	21.5	22(2)	22.5(2)	23	23.5(2)	24	25	26.5				
	1	1.5	0.5	0.5	0.5	0.5	0.5	1	1.5				
<i>d) Floor timbers, molded</i>													
7	9(3)	11	12(3)	13	14(2)	15	17						
	2	2	1	1	1	1	2						
<i>e) Floor timbers, sided</i>													
5.5	7(6)	7.5	8	8.5	10	12	17						
	1.5	0.5	0.5	0.5	1.5	2	5						

Note. All values given in centimeters. Number in parenthesis indicates frequency.

more in the molded than in the sided dimension. The same result is obtained when the values are arranged in a linear progression for each of the aforementioned dimensions (Table 1d). The distribution of molded dimension indicates small differences (1 cm) for values concentrated between 9 and 14 cm, with somewhat larger gaps at both extremities. This central tendency is accentuated not only by the small differences between the molded values situated in the middle of the distribution but also by the frequency of these values. A resistant summary of this distribution shows a balanced repartition of values (Table 2d). Nevertheless, the data cannot be integrated as a normal curve since only one condition of equality is fully satisfied ($5 = 5$; $3 \neq 2$; $2 \neq 3$). Here, we find rather a particular case of multiple-peak distribution, which shows that floor timbers have a tendency to split in dimensional categories (Figure 3). This tendency seems also related to the vessel size: the 9-cm molded value is found in ships with LOA (length over all) = 10.7–11.9 m and B (breadth) = 2.35–2.52

m; the 12-cm molded value was observed in ships with LOA = 13.3–13.5 and B = 2.46–3.4 m; and the 14-cm value was recorded in vessels with LOA = 13.76–17.36 m and B = 3.35–2.78 m. However, the small sample size and the existence of odd values (9-cm value—Puck 2 with LOA = 15.86 m and B = 2.54 m; 12-cm value—Ralswiek 2 with LOA = 9.5 m and B = 2.5 m; 15-cm value—Eckernförder with LOA = 11.5 m and B = 3 m) in the same molded range weaken the strength of such a relationship.

As mentioned before, floor timbers seem to have less variation in the sided dimension, and this lack can be seen in their linear progression (Table 1e). The relatively large number of cases concentrated at the 7-cm value and the presence of high values only at the upper extremity of the distribution indicate that floor timbers tend to be about 7 cm sided (Figure 4). This trend does not seem related to the size of the vessel nor to its place of discovery. The resistant summary for this distribution confirms that most of the cases are clustered in between the median (7) and the

lower quartile (7), while the tail of the distribution spreads from the upper quartile toward the upper extremity (Table 2e). The identical values obtained for the median and the lower quartile ($7 = 7$), the considerable discrepancy between the midspread and the highspread ($1.5 \neq 10$), and the fact that the lower quartile is minimally distanced from the extremity compared with the distance between the upper quartile and the other extremity ($1.5 \neq 8.5$) indicate that the median is off-center regarding the hinges and that the midspread is off-center in respect to the extreme values of the distribution. However, it seems that the skewness of this distribution is not related to the vessel size: extreme values (Frombork—17 cm; Ralswiek 1—12 cm; Mechlinki—10 cm) are found not only in the larger vessels (Frombork with LOA = 17.36 m and B = 2.78 m; Ralswiek 1 with LOA = 13–14 m and B = 3.4 m) but also in the smaller ones (Mechlinki with LOA = 9.32 m and B = 2.47 m).

Dimensional variability of floor timbers can be better visualized if a line of fit is drawn onto a scatter plot (not provided here) of both molded and sided distributions. The interesting feature revealed is the slight tendency of both sided and

TABLE 2
RESISTANT SUMMARY OF PRINCIPAL VALUES

<i>a) Keel, molded</i>					
10	10.5	11.75	12.5	14.5	
	0.5	1.25	0.75	2	
		1.75	2	2.75	
<i>b) Keel, sided</i>					
13.5	20	21.5	28.5	49	
	6.5	1.5	7	20.5	
		8	8.5	27.5	
<i>c) Planks, average width</i>					
19	22	22.5	24	26.5	
	3	0.5	1.5	2.5	
		3.5	2	4	
<i>d) Floor timbers, molded</i>					
7	9	12	14	17	
	2	3	2	3	
		5	5	5	
<i>e) Floor timbers, sided</i>					
5.5	7	7	8.5	17	
	1.5	0	1.5	8.5	
		1.5	1.5	10	

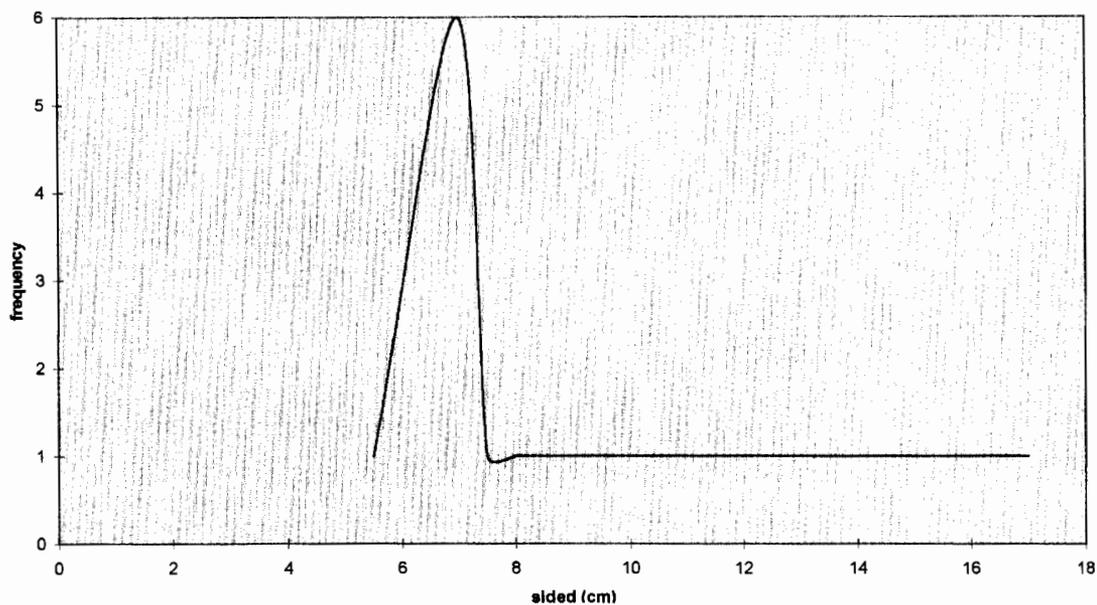


FIGURE 4. Skewed distribution of sided values for floor timbers in the Southern Baltic.

molded distributions toward a positive relationship with the length of the vessel.

Proportions

The second aspect under consideration is proportionality between keels. As mentioned earlier, all the finds except the Szczecin shipwreck had keels with T-shaped cross-sections in the middle body. The M/S ratio, obtained by dividing the total molded (M) by the total sided (S) dimension, shows that keels from the Southern Baltic region are shallow and that about half of the keels are sided roughly twice the molded dimension: Szczecin = 0.41, Mechlinki = 0.52, Gdańsk-Orunia 2 = 0.50, Bągart = 0.44, Eckernförder = 0.67, Kamień Pomorski = 0.53, Ralswiek 4 = 0.50, Gdańsk-Orunia 1 = 0.78, Charbrów 1 = 0.38, Gdańsk-Orunia 3 = 0.57, Czarnowsko 1 = 0.6, Puck 2 = 0.57, Frombork = 0.23. It is noteworthy to mention here that with one exception (Mechlinki—12 cm), all keels have a molded dimension below the bearding line between 6 and 9 cm, the most frequent being the 6-cm value.

As main constructional elements, the posts incorporate proportions related to the final shape of the hull. Unfortunately, very few posts were uncovered on the southern shores of the Baltic,

and this circumstance renders inadequate any statistical approach.

Nevertheless, several finds, such as the posts of the first two shipwrecks uncovered in Gdańsk-Orunia, exhibit several interesting details. The sternpost of Gdańsk-Orunia 1 appears to have a more abrupt curvature than the stem of Gdańsk-Orunia 2 due to the flattening of the outer face at the lowermost end. This appearance is accentuated also by the asymmetry in the molded dimension: at the junction with the garboard hooding ends, the Gdańsk-Orunia 1 sternpost measures 32 cm while at the junction with the uppermost wing it is only 18 cm. In contrast, the stem of Gdańsk-Orunia 2 has a constant molded dimension (25 cm) for its entire length. However, the similarity between the two posts is revealed when the curvature of the outer face is traced beyond the ends of the posts. In both cases, a circle with a radius of 1.43 m is obtained.

The sternpost from Gdańsk-Orunia 1 exhibits also another important detail. Three steps were carved into the inner face of the sternpost for the joint with the wings and the hooding ends of the garboard strakes. The uppermost end of each of these steps is circumscribed in a circle with a radius of 88 cm, which is in fact the interval distance, measured from center to center, between frames in the hull. In fact, the shipwrecks found at Gdańsk-Orunia are a unique example of proportionality between different timbers. All three wrecks show similar ratios for keel and beams. If an inverted ratio (sided/molded) is used, then the same similarity can be observed between keel, beams, and floor timbers.

TABLE 3
STEM-AND-LEAF DISPLAYS FOR MOLDED AND
SIDED VALUES OF KEELS

a	b
110.0 0.0 0.0	113.5
110.5	118.0
111.0 1.0	119.0
111.5	210.0 0.0
112.0 2.0 2.0	211.0 1.0 1.0
112.5	212.0
114.0	214.0
114.5 4.5	215.0
	218.0
	219.0
	310.0
	315.0
	419.0

Conclusions

While not exhausting the possibilities of exploratory data analysis of principal hull members, the present exercise reveals scantlings recorded for certain hull timbers from early medieval vessels found on the southern shores of the Baltic Sea. If we are to summarize these observations for a hypothetical reconstruction of an "average" vessel, the most probable list of scantlings for

the hull timbers under analysis would read as follows:

- a T-shaped keel about 11.75 cm molded and 21.5 cm sided; that is, an M/S ratio of about 0.54 (width almost double the height);
- posts with an outer face following an arc of a circle with a diameter of 2.85 m and an inner face following an arc of a circle with a 1.76-m diameter (if Gda_sk-Orunia 1 and 2 posts are chosen as models);
- planks 22.5 cm wide and 2 cm thick;
- floor timbers about 12 cm molded and 7 cm sided.

Although these values outline what proportions ought to be expected from the sample size under analysis, they are not representative per se and as such, they should not be regarded as representative values for Southern Baltic shipbuilding. Instead, the whole range of values, or at least the midspread, should be regarded as approximate values for specific timbers within a hull. This approach would satisfy at least one historical circumstance in which the early medieval shipbuilder (Old Norse *stafnsmiðr*) would have worked the keel, the posts, and the blanks for the shell by eye. For this shipbuilding method, few or no measuring tools would have been necessary. As Christensen (1982:334) observes,

Measuring tools are again generally of wood, and none have been found. . . . The boat ell and boat level used by boatbuilders today may well have Viking Age ancestry, but this cannot be proved.

However, the surprising narrowness of most dimensional-midspread ranges and, where applicable, also the shape of the timber (e.g., T-shaped keels or rectangular floor timbers) suggest that these vessels were built according to some rules of thumb reflected in the ratios found between different hull timbers or between timbers from the same class but from different hulls. The use of such rules in early medieval shipbuilding in the Baltic area seems to have

been a common practice, the method being already documented for the Scandinavian material dating from the same period, as observed below:

. . . only if the Viking-Age shipbuilder master, the so-called "stem-smith," had a set of rule-of-thumb to work from. Of course there is reason to believe that the experience gained by his predecessors had been laid down in such rules. Within the Nordic boatbuilding tradition, still alive in some parts of Scandinavia, a number of parallels can be found to such rules . . . (Crumlin-Pedersen 1986:143).

Furthermore, this assertion would accord with the fact that no proportions can be assigned to a specific geographic location, but rather they seem distributed along the Southern Baltic coast, specifically in Schleswig-Holstein, Mecklemburg, and Pomerania.

From another point of view, some of these values fall very close to the basic units used to measure length in Northern and Eastern Europe. The molded dimension of the Frombork shallow keel is six times a Swedish finger, while the sided dimension is more than three times a Swedish half-foot (calculated at 14.85–15 cm). Out of 17 measurements taken for the Puck 2 shipwreck, about one third are multiples of 3, while another third represent multiples of 2. The last category can be calculated in Danish Sjaelandsk fingers (1.963 cm).

The room interval measured in the first shipwreck from Gdańsk-Orunia equals two Russian *lokoti* (44 cm) or one Russian *poliusajeni* (88 cm), both measurement units being in use in Russia between the 9th and the 13th centuries (Rybakov 1949:68). On the other hand, the values obtained for the width of the planks in most ship finds are similar with Polish *piędzię* or Russian *piedi* which is half a *lokoti* (18–19 cm or 22–24 cm depending upon whether it is a short ell or long ell).

In conclusion, the archaeological material unearthed on the southern shores of the Baltic shows a certain degree of cohesion regarding the dimensional proportions and the shape of hull timbers. This characteristic seems to point to the existence of a specialized work force, a restricted

group of craftsmen who seem to have used different measurement techniques to produce ship timbers similar in design and dimensions. Whether they used a unified measurement system or regional variations of a more general system still remains a matter of debate. While only some of the ship finds show a certain degree of numerical cohesion regarding dimensions and proportions, the elusiveness of incremental pairing of different dimensions within the same hull seems to suggest that more data is necessary before a clear verdict can be pronounced on this matter.

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Preliminary Report on the 1996 Excavation of the Wreck of *Ha 'aheo o Hawaii* (ex-*Cleopatra's Barge*) in Hanalei Bay, Kauai

Introduction

In July 1995, the Smithsonian Institution's National Museum of American History (NMAH) conducted a survey for the wreck of *Ha 'aheo o Hawaii* (ex-*Cleopatra's Barge*) in Hanalei Bay, Kauai, Hawaii. When it sank there on 5 April 1824, the hermaphrodite brig was the Royal Hawaiian Yacht of King Kamehameha II (Crowninshield 1913; Whitehill 1959; Ferguson 1976). The purpose of the 1995 survey was to locate and assess the remains of the famous vessel—the first deep-water yacht built in the United States (Johnston 1996). The survey succeeded, and in July 1996, the NMAH began excavations of the famous ship under the first scientific underwater archaeological permits ever issued by the state of Hawaii.

The 1996 Excavations

Twelve excavation trenches were permitted by the state of Hawaii and the federal government for 1996, under the same terms and conditions as the 1995 survey trenches. Due to the depth of the sand overburden covering the site, they were excavated by means of a propeller-wash deflector secured to the bottom of the project research vessel. In accordance with the permits' terms, all trenches were surveyed into a master map and backfilled after excavations were completed. Bottom time for the 1996 season totaled 38.21 hours.

Findings

Most of the finds paralleled those from the 1995 season in type, although somewhat larger quantities were recovered in some categories.

Both organic and inorganic artifacts from the past 2 centuries were recovered. As with the 1995 survey, artifacts were found together with a large and often bizarre admixture of modern, intrusive material. Among the organics were bone, rope, and wooden artifacts. Inorganics comprised ceramics, iron-content concretions, copper fasteners, glass, copper hull sheathing, lead, and ballast. For the first time, both categories yielded Native Hawaiian artifacts. In addition, during the last week of the 1996 excavation, some hull structure was located beneath and against the reef surrounding the site. Adjacent to it was a fragmentary piece of red-and-black painted wooden furniture—probably from a large table or case piece (Wachowiak 1996). It and the hull fragments were recorded, photographed, and reburied.

Artifacts found in the trenches were recovered, cataloged on-site, and deposited in bay (salt) water. After the fieldwork was completed, artifacts were transported to the NMAH in Washington, DC for further treatment, documentation, and study prior to their return to Hawaii. The results presented below are preliminary; further study is necessary before any conclusions may be drawn.

Inorganics

Numerous copper and iron hull fasteners were recovered from various trenches, with a concentration in trench E12 against the reef. Along with some reworked fragments of copper hull sheathing (Figure 1) and a sharpened copper spike, these fasteners are discussed below in the section on hull structure.

Lead finds included a small, folded scrap of lead sheet probably intended for patching material (L5), five musket balls (L6), a short section of wood-encased lead pipe (L7), and a longer, bent section of lead pipe crimped at both ends (L8). This piece, which measures 18 $\frac{1}{8}$ in. in length and 1 $\frac{1}{4}$ in. in diameter, probably represents part of the ship's original plumbing. A Native Hawaiian artifact was recovered in the form of a small, triangular piece of lava pierced from both sides with a hole at one corner

(MISC4b). This piece is tentatively identified as a small reef anchor (Figure 2). Sixty-three concretions of varying shapes and sizes also were recovered and are undergoing radiography and other analyses at this writing.

Eighteen ceramic specimens were recovered from various trenches and from the surrounding reef, including two intact and three fragmentary bricks as well as shards of stoneware, earthenware, whiteware, pearlware, and porcelain. Glass finds datable to the period of the wreck comprised case bottle fragments (G13–15 and G20) and the corner of a thin, clear window pane with bubble inclusions (G16). The gin bottle remains appear to be from three different containers and therefore begin to build a body of evidence supporting missionary Hiram Bingham's (1981[1847]:218) contemporary assertion that spirits caused the royal yacht wreck. Further research also should reveal whether a clear, very thin-walled, curved glass fragment with remnants of fluting along one edge (G11) represents a

tableware item (tumbler or goblet) from the wreck as well.

Organics

Organic artifacts from the 1996 campaign largely mirrored those from the 1995 season, with a few notable exceptions. Among the six bone fragments recovered, only one bovine (*Bos taurus*) and one chicken (*Gallus gallus*) bone could be positively identified. Three more are large pig (*Sus scrofa*) or small cattle bones, one of which may show signs of butchery (B8). Another of this group, identified as cattle due to its size, appears to be a tibia reworked into a long, tapered awl or polished shellfish meat pick (B11) (Kirch 1985:193, Figure 170). The last is the right mandible of a sheep or goat at least 4 years old (Zeder 1996). A fragment of a large, shallow bowl (MISC6) apparently made of gourd ostensibly represents a Native Hawaiian poi bowl (Adrienne L. Kaepler 22 October 1996, pers.



FIGURE 1. Piece of copper hull sheathing folded several times and subsequently rounded off on one end (HS18), indicating reuse. (Photo by Rick Vargas; courtesy of the Smithsonian Institution.)

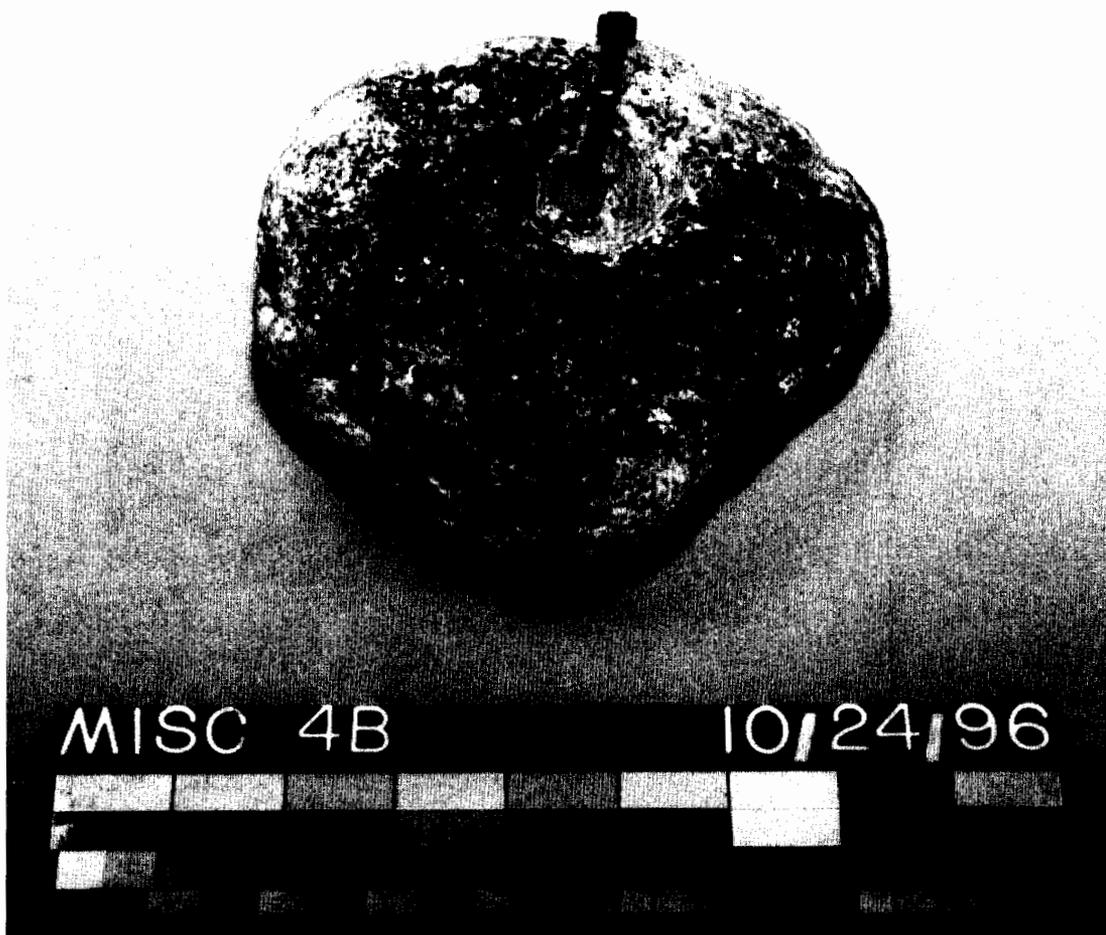


FIGURE 2. Triangular piece of lava pierced from both sides with hole at one corner (MISC4b) tentatively identified as a Hawaiian reef anchor. (Photo by Rick Vargas; courtesy of the Smithsonian Institution.)

comm.). Its material will be analyzed shortly (Figure 3).

As outlined below, several wood samples were recovered for sourcing and identifying. Most were associated with hull remains, although one appears to be a fragmentary gun carriage wheel (W13). Several short sections of rope recovered from trench E12, where the hull remains were discovered, likely are associated with the hull. Two strips of thick leather, both with stitching holes along opposite edges, were found in the same area. The longer sample is 36 in. long, with the stitching along the long edges, remnants of reddish pigment (red lead?) on both sides,

and one beveled end. These strips are tentatively identified as chafing gear, sewn around heavy line to prevent it from wearing through. A well-preserved wooden block found in the same area was strapped with leather-covered rope (MISC5), indicating it was a part of the running rigging.

Hull Structure and Scantlings

During the last week of the 1996 excavation, the bay's chop subsided enough to permit R/V *Piliialoha* to back up to the reef which *Ha 'aheo* struck (Bingham 1981[1847]:221–23) and set an excavation trench (E12) against it. Only a few



FIGURE 3. Section of a large, shallow food (poi?) bowl apparently made of gourd (MISC6). (Photo by Rick Vargas; courtesy of the Smithsonian Institution.)

feet beneath the surface of the sandy bay bottom, considerable hull remains were discovered lodged against and beneath the reef edge. These remains include what appears to be a portion of one of the ship's ends: partial floors and first futtocks, strakes (some with copper sheathing and lead patching attached), and a possible deck beam with decking. All the major timbers were disarticulated and had been deposited in disassociated positions. Moreover, many were degraded and missing their edges and ends, rendering detailed measurement and interpretation difficult.

Recording was further exacerbated by heavy rains and consequent flooding of the Waioli River, which cut through a sandbar at the river mouth and dumped silted flood water directly onto the site.

One visible section of timber measured 11 ft. in length. Its sided and molded dimensions are 9½ and 11 in. respectively. Along its molded face are several 1-in. treenails and two shallow, rectilinear notches where other timbers originally intersected it, along with several heavily concreted iron fasteners. The eastern end continued

into the trench balk; the western end extended beneath another frame piece into the balk on the other side of the trench. If it is a section of the keelson, its measured angle of 28° on the basal surface indicates a relatively flat deadrise, although some of its other features present interpretive problems. From its basal surface, a heavily concreted, 1-in. iron drift fastened it to a floor. This member's molded dimension tapered from a maximum of 9 in. (at the 28° angle directly below the keelson) to 6 in. at the eastern end. The western end is eroded. Its preserved length measured 6 ft. $6\frac{1}{2}$ in., and several trenails protrude from its basal surface at ca. 6-in. intervals. However, the absence of an observed flat on the bottom surface of the floor, which should be evidence for fastening to the keel, could indicate that these attached members represent transom timbers.

One of the disarticulated futtocks/floors ($4\frac{1}{2}$ in. sided and $9\frac{1}{2}$ in. molded) had three fragmentary strakes still attached to its basal surface. These strakes measured $3\frac{1}{2}$ in. in thickness and $7-7\frac{1}{2}$ in. in width. One of these strakes is fashioned of two thicknesses of wood, indicating either a patch or a pieced member. Other fragmentary framing timbers varied widely in their sided and molded dimensions, warranting further documentation and study.

On the western edge of trench E12, a 6-ft.-3-in. straight timber with one cut and one eroded end was observed lodged beneath the coral reef. Measuring $5 \times 5\frac{1}{2}$ in. in width and thickness, it had five 6-x-3-in. timbers butted together and fastened at its cut end. Since these dimensions differ significantly from the other framing/sheathing timbers, it is believed that this assemblage may represent portions of a deck beam and



FIGURE 4. Hollow, ovoid glass bulb and fragmentary wood frame from sandglass (CON44). (Photo by Richard Strauss; courtesy of the Smithsonian Institution.)

decking. A fragmentary, bevel-ended frame containing a concreted fastener through the bevel perpendicular to the frame side appears to be a hawse piece. However, the edges and end are too eroded and worm eaten to derive useful measurements.

Also located and recorded were two sections of what appear to be molded rails or railings of various dimensions. One with a rounded upper surface appears to be a cap rail, despite its asymmetrical moldings on either side. The other had traces of red pigment on all four sides, indicating the original presence of paint. Samples were taken of all these timbers for wood identification. Based on its presence in trench E12 against the reef, it is currently believed that this hull structure represents portions of the bow area of the ship, although further study is warranted prior to any final conclusions in this regard.

Fasteners and Sheathing

All observed strakes were fastened to frame members with unwedged, octagonally faceted, 1-in. treenails. Five disassociated copper drifts also were recovered, ranging in diameter from $\frac{5}{8}$ to 1 in. Two slightly bent examples were intact: one measuring 2 ft. in length and $\frac{3}{4}$ in. in diameter still retained a clinch ring as a rivet at its bottom end. Several smaller, square and round copper fasteners also were observed, both set into frame timbers as well as lying alone on the bottom of trench E12. Nine were recovered. A $4\frac{1}{8}$ -in.-long round copper spike was sharpened to a point at its end, indicating reuse as an awl or shellfish meat pick (C11) (Kirch 1985:193, Figure 170). The most unusual copper artifact recovered during the 1996 season was a small, intact, cast copper wedge measuring $2\frac{1}{8}$ in. in length and tapering to a chisel point. Its use is unknown at present.

As in the 1995 survey, several disassociated pieces of copper hull sheathing were recovered during the 1996 excavation. All fragmentary, they are still undergoing surface cleaning at this writing and have revealed no manufacturers' stamps to date. In addition to the customary flat or crumpled pieces, three were recovered that

consist of long, narrow sections of edge segments that were folded over two or three times. Although identical pieces are preserved in the NMAH artifact assemblage from the 1838 wreck of the French frigate *Herminie* in Bermuda, their purpose is unknown (Waters 1996). Perhaps they were used as sheathing seam patches or stored aboard ship as scrap to be melted down and reused. One folded, wider piece (HS18) has rounded edges at one end, clearly demonstrating some sort of reuse (Figure 1). Another section of copper sheathing was observed and recorded in situ fastened to the above-mentioned strakes. Its crumpled, almost pleated condition attests to the violence of the yacht's close encounter with the reef in 1824. Nearby, a segment of corroded lead sheathing attached in situ to a strake seam probably served as a patch.

Related Research

After the 1995 survey and subsequent radiography, several concretions with fasteners or multiple artifacts inside were forwarded to the Conservation Research Laboratory of the Nautical Archaeology Program at Texas A&M University for reduction and/or casting. A majority were wrought-iron fasteners of various sizes concreted to other artifacts or to the surrounding sand (CON2/7, 3, 24-26, 28, 32, 48-50, and 60). These artifacts were all mechanically cleaned and, where appropriate, cast with hysol epoxy and cosmetically enhanced to resemble the original artifact. Other artifacts emerging from the reduction process included an iron doorknob with a square shaft (CON1) and a T-shaped iron tool handle and partial shaft in a leather holster (CON36). The artifact appears to represent a fragmentary sail maker's heaver or stitch mallet (Ashley 1944:19, Figure 85; Schwendinger 1989:31). A curved, wrought-iron hook fashioned from flat strapping (CON36) may be a doubletree, used for hanging pots over a hearth (Lasansky 1980:63). Other concreted objects include a hollow, ovoid glass bulb and wooden frame fragments from a sandglass (CON44; Figure 4); a single-blade folding knife (CON52); a two-tine iron fork missing its handle (CON55);

a rivet-ended and washered wrought-iron eyebolt with an iron ring through it (CON64); and an eyebolt with a segment of leather-wrapped rope on an iron thimble through it (CON65).

Conclusions

The discovery of portions of the hull at the reef, along with the furniture fragment, was unexpected and most welcome: nothing observed on the site up to that point had indicated that such features would be preserved in the very dynamic environment in which the wreck lies. Equally significant was the small assemblage of Native Hawaiian artifacts from the royal yacht, particularly in light of the paucity of material culture directly attributable to the early Hawaiian monarchy. More research should offer further insights into the significance of these and other finds from the 1996 season. Further, the importance of the recent finds indicates the desirability of another season. Consequently, over the winter of 1996–1997, permits will be sought for at least one more season of excavation.

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of East Carolina University oversaw artifact desalination and conservation; Thomas Ormsby of the National Museum of Natural History (NMNH) produced artifact drawings; and Dr. Melinda Zeder of the NMNH analyzed the 1996 bones. Susan Lebo of the Bishop Museum in Honolulu reviewed the pottery and glass artifact assemblages and generously shared her knowledge of their chronology and contemporary distribution patterns in the Hawaiian islands. Radiography of the concretions was conducted by Camie Thompson, Melanie Feather, and Ron Cunningham of the Smithsonian Institution's Conservation Analytical Laboratory (CAL). Melvin J. Wachowiak, Jr. of CAL provided considerable insight into the furniture find. J. Richard Steffy was kind enough to review our documentation of the hull structure and offer suggestions as to interpretation.

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The Rhenish Stoneware from the Monte Cristi Shipwreck, Dominican Republic

Introduction

The Monte Cristi shipwreck, which has been under excavation by the Pan-American Institute of Maritime Archaeology (PIMA) and Earthwatch since 1991, is a northern European merchantman which sank in less than 5 m of water in Monte Cristi Bay on the north coast of the Dominican Republic, probably between 1652 and 1656. The nationality of the ship is still in question; dendrochronological studies have revealed that the ship was of English manufacture, but the ship's cargo appears to have originated primarily in the Netherlands. Also known as the Pipe Wreck, this site is most well known for the thousands of clay tobacco smoking pipes and pipe fragments which made up the largest portion of the ship's cargo (Hall 1996).

In addition to the pipes, however, other finds from the site have provided critical insight into the understanding of the shipwreck. Artifacts such as ceramics, trade goods, and luxury imports are well represented in the ship's cargo. One important ceramic type which has been excavated in quantity from the wreck is salt-glazed Rhenish stoneware, which was produced in the region around Cologne during the 16th and 17th centuries, most notably for this study in the town of Frechen.

The Production and Export of Rhenish Stoneware

The most common type of stoneware manufactured in Frechen was a durable, heavy, necked bottle with a flat base, a full, round body, and a single vertical strap handle, produced throughout a period of more than 200 years (Thwaite 1973:255). Frechen stoneware bottles were made of high-silicate clay, which when fired at extremely high temperatures (around 1300°C),

would vitrify and become hard and impermeable. The distinctive speckled effect on the stoneware's surface was caused by the presence of iron salts in the clay. These salts reacted upon firing and created either dark brown freckles or a more uniform brown color, depending upon the fineness and dispersion of the iron granules in the clay. The glaze was made simply by throwing damp sea salt into the kiln during the firing process. The salt would vaporize and react chemically with the silica in the clay forming a mineral film evenly on the surface of the ceramic (Elliott 1986).

Rhenish stoneware bottles were often decorated with bearded faces or masks on the neck and floral or heraldic medallions on the body, all of which were pressed into wooden molds and applied to the bottles before firing. Blue cobalt was often splashed onto the masks and medallions before firing to add color. The bearded faces on the necks of the bottles, known as *Bartmänner* or beardmen, are perhaps the most distinctive and diagnostic characteristic of this type of Rhenish stoneware, examples of which are often called *Bartmannskrüge* or beardman jugs. Rhenish *Bartmann* bottles are also often called Bellarmine ware, referring to the idea that *Bartmann* masks were originally modeled after Cardinal Roberto Bellarmino (1542–1622) in an attempt to caricature this hated Roman Catholic theologian on Protestant drinking vessels. Although Rhenish stoneware was often referred to as Bellarmine even in the 17th century, *Bartmann* masks could not have been created in Bellarmino's image, since Bellarmino was only 8 years old when the earliest dated example was made in 1550. It is highly unlikely that he had either a heavy beard or a reputation which would make him worthy of caricature at that age (Holmes 1951:173; Thwaite 1973:258).

After production, the stoneware was shipped to Cologne, where it was transported down the Rhine river to the Dutch coast. From there it was exported both to other European countries and to far-flung European colonies throughout Asia and the New World. Rhenish stoneware was originally used as a container for Rhenish wines, but it was also eventually used as a

household storage vessel and as a transport jar for vinegar, oil, acids, and mercury (Thwaite 1973:255). For archaeological purposes, Rhenish stoneware serves as an excellent index fossil for the 16th and 17th centuries on both underwater and terrestrial sites. Its impermeability and hardness generally leave it in an excellent state of preservation which is particularly valuable for artifacts from an underwater context.

The Study of the Monte Cristi Rhenish Stoneware

In the summer of 1995, the Dominican Comisión de Rescate Arqueológico Submarino allowed all of the Rhenish stoneware which had so far been recovered from the Monte Cristi wreck to be transported temporarily to Texas A&M University for conservation and analysis. Although no complete vessels have yet been excavated on the site, the 1,371 shards which have been raised have yielded a considerable amount of information.

These shards, currently in study, can be organized in several different ways. First, they can be divided into types of shards: 1,291 body shards (22 with handle fragments), 52 base shards, and 28 rim shards (3 with handles). They may also be divided on the basis of decoration: 290 shards have molded decoration; 116 shards (69 of which also have molded decoration) have traces of cobalt; and 1,034 shards are undecorated. Finally, the shards may be grouped according to the original size of the vessel. Fifteen of the shards, based on their wall thickness and approximate reconstructed diameter, came from very small bottles, pitchers, or juglets. These small shards probably represent the ship's tableware rather than its cargo. Six of these small shards are the gray color typical during the mid-17th century of stoneware from Westerwald, another important town in the Rhenish stoneware industry (Von Bock 1986:65-70).

The original intent of this investigation was to compare the Monte Cristi shards and their decorations, namely the *Bartmänner* and the medallions, to similar examples from the existing Rhenish stoneware typology in order to help

determine the date and specific origin of the Monte Cristi assemblage. Consequently, this paper will address only the shards with molded decoration. The preliminary findings, outlined below, have already begun to present a clearer picture of the Monte Cristi Rhenish stoneware.

The Bartmänner

The decorations on the Monte Cristi stoneware fall into two categories: *Bartmänner* and medallions. Looking first at the bearded masks, it is possible to see that out of a total of 24 shards with *Bartmann* decoration, 25 masks are represented (one shard has both a neck mask and a small shoulder mask). These 25 faces can be divided into eight different types, although three of these types are only partially preserved, and seven shards have *Bartmann* fragments which are too small to be recognizable as any type.

The most common *Bartmann* type of the Monte Cristi Rhenish stoneware is represented in six examples. It consists of a large mask with a mustache and beard represented by flowing wavy lines and a straight, horizontal mouth which resembles a ladder (Figure 1a). The second *Bartmann* type, which is preserved in four examples, has a beard in a stylized palmette pattern and a branched line like a strand of wheat between the eyes and eyebrows (Figure 1b).

The rest of the Monte Cristi *Bartmann* types are each represented by only one or two examples each. The third type (Figure 1c), which is preserved only in the lower portion of two examples, has a stylized palmette beard with a central wheatlike strand down the center and an hourglass-shaped mouth outlined with a ladderlike pattern. The fourth type (Figure 1d), represented by a single example of a complete face, has a beard represented by smooth, simple lines and an hourglass mouth with a curved horizontal line in the center and curved vertical lines at the sides. The fifth type (Figure 1e), the two examples of which are preserved only in the lower half, seems to be similar to, although somewhat smaller than, the previous type. It has the same hourglass mouth and smooth beard; the only difference is the addition of small vertical

lines in the center of the mouth, above the single curved horizontal line, and the addition of small horizontal lines at both sides of the mouth, just outside the last curved vertical lines. The sixth type (Figure 1f), which is preserved only in the upper half of a single example, is notable for its excessively long eyelashes and similarly spiky eyebrows and the very long wheatlike strand between the eyes.

The last two *Bartmann* types are rather different in that they are both much smaller than the preceding types and are preserved, each in only a single example, on shoulder shards instead of neck shards. The seventh type (Figure 1g) has a smooth, rounded beard represented by curved lines and three circles in the mouth region. The eighth and final type (Figure 1h) has only a bushy mustache and no beard. This small, mus-

tached face is on the shoulder of a large shard which preserves one bottle's entire rim, neck, handle, and the *Bartmann* illustrated in Figure 1b.

Although chronologies based upon the appearance and characteristics of *Bartmänner* have been attempted (specifically by Holmes [1951]), it is difficult to assign dates to Rhenish stoneware bottles by relying solely on the mask forms. Holmes's gradual progression from finely modeled, naturalistic faces to more stylized masks with smiles and grimaces to crudely executed faces scratched onto the surface of the vessels is generally consistent, but the use of certain *Bartmann* types frequently spanned several decades. The Monte Cristi *Bartmänner*, which are neither the highly naturalistic faces of the 16th century nor the crude afterthoughts of

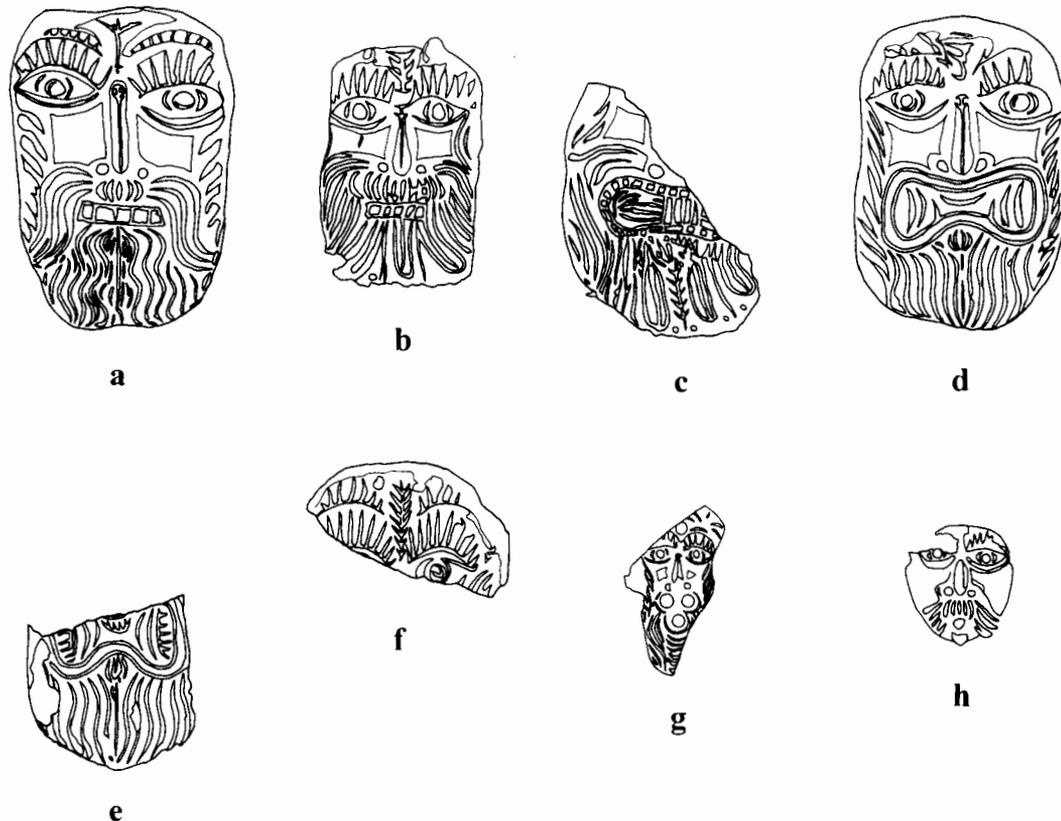


FIGURE 1. The eight types of *Bartmänner* from the Monte Cristi Rhenish stoneware. Maximum preserved dimensions: a, 8.7 x 6.1 cm; b, 6.8 x 4.4 cm; c, 7.1 x 5.3 cm; d, 8.5 x 5.8 cm; e, 4.8 x 4.5 cm; f, 3.5 x 5.6 cm; g, 4.6 x 2.8 cm; h, 3.3 x 2.9 cm.

the late 17th and early 18th centuries, probably date to the mid-17th century, as shown by parallels to the Monte Cristi masks which range in date from 1625 to around 1690 (Thwaite 1973:260, Figure 8; Stanbury 1974:7, Type F; Green 1977; Hurst et al. 1986:220–221, Plate 44; Von Bock 1986:256–257, Figure 329a). Although Rhenish stoneware *Bartmänner* can be assigned to approximate periods based on style, the extent to which various types were reused across the span of decades makes them unreliable as strict indicators of date.

The Medallions

A total of 268 shards bears traces of molded medallion decoration. Although 121 of these medallion shards remain unidentified because of extensive damage or breakage, the other 147 shards can be categorized into nine different medallion types. The first four types (Figure 2) are all floral medallions, none of which have

been recovered in quantity. Six shards with examples of the design illustrated in Figure 2a have been raised, and the designs in Figures 2b–2d are all represented in three or fewer examples.

The two medallion types which have been recovered in by far the greatest quantities are illustrated in Figure 3. Figure 3a shows a soldier or sportsman dressed in a doublet, a ruff, breeches, a sword, and a plumed hat, with his left hand on his hip. In his raised right hand he is holding what may be a drinking glass, a bell (Hall 1996:168), or a musket rest (Holmes 1951:175). Between his feet is some kind of brickwork or masonry with plants springing up from the ground. A total of 55 shards with fragments of this design has been recovered to date.

Figure 3b illustrates the only medallion in this study which has complete examples, although none of the 60 shards with this design were intact upon excavation. Represented on this medallion is an achievement of arms which shows a

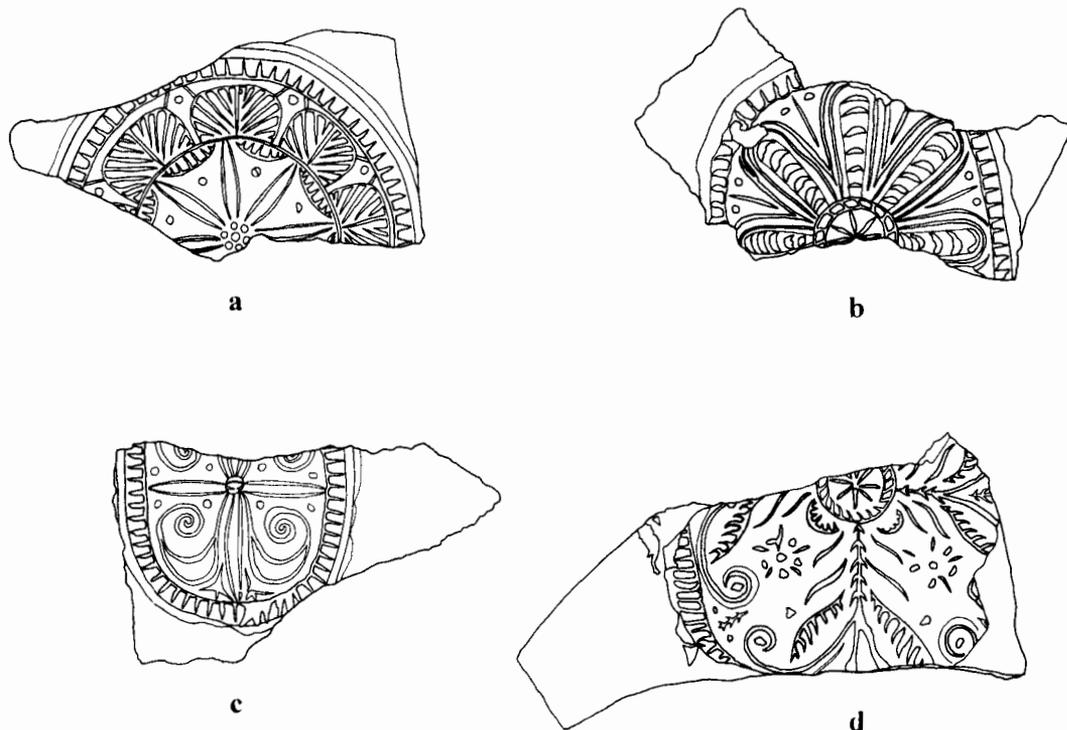


FIGURE 2. Four Monte Cristi shards with floral medallions. Maximum dimension of shard: a, 6.5 x 11.4 cm; b, 7.1 x 12.5 cm; c, 6.3 x 11.1 cm; d, 8.8 x 14.6 cm.



FIGURE 3. The two medallion types which appear on the Monte Cristi stoneware most frequently. Medallion *a* is a reconstructed composite after several shards; *b* illustrates a complete medallion (11.0 x 9.1 cm).

shield bearing in the chief register a lion counter-passant, with four chevronels, and a blank escutcheon below. Over the shield is a pillar surmounted by a crown. Heraldic designs are common medallion decorations on Rhenish stoneware, but the question which naturally arises is whether or not the achievement of arms which is shown represents an actual family, town, or region, since corrupt or imaginary arms were frequently represented, especially toward the middle and later 17th century. In this case, it is unlikely that the shield is an authentic achievement of arms, primarily because of the direction the lion is facing. In heraldic design, animals are almost always represented facing to dexter, or to the right of the person who would be holding the shield (Scott-Giles and Brooke-Little 1966:66). The lion in Figure 3b is shown facing to sinister, and along with the simplicity and generality of the other charges, it is a strong indicator that this achievement of arms is not genuine.

The final three Monte Cristi medallion designs are also heraldic. The first of these designs (Figure 4a), which is preserved in only a single example, shows a shield with two chevrons and a lion passant above the shield. Some detail, how-

ever, is obscured due to damage which the medallion sustained in application. In the right half of the medallion, it is possible to see four fingerprints which the potter left as the molded clay was pressed onto the bottle prior to firing. The next design (Figure 4b) has been reconstructed as a composite of seven shards which retain fragments of the medallion. This shield bears a lion rampant, bends to dexter and to sinister, and an object which resembles a harp. The final medallion design (Figure 4c), a composite of 13 shards, shows a shield bearing a lion rampant opposite two chevrons and a chessboard pattern. The figure over the shield is rather unusual; it shows the head and neck of an unidentified animal wearing a collar. The pattern on its neck probably represents scales, feathers, or spots, and flames or a tongue emerge from the end of its long snout. No parallels have yet been found for this animal, probably a dragon (although possibly an eagle or griffin), but its singularity and emphasis on this medallion make it intriguing.

So far, none of the arms on the Monte Cristi medallions have been associated with a particular family, town, or region. However, almost all of the charges borne on the shields from these



FIGURE 4. Three Monte Cristi heraldic medallions. Maximum preserved dimension of medallion *a* is 9.9 x 9.3 cm. Medallions *b* and *c* are reconstructed composites.

medallions, such as the lions, the chevrons, the chessboard, and the crown, are common motifs from other genuine arms which were molded onto Rhenish stoneware in the late 16th century and the first half of the 17th century, including the arms of the city of Amsterdam and of the duchy of Jülich-Kleve-Berg-Mark-Ravensberg (Stanbury 1974:3, 5; Hurst et al. 1986:220, Plate 44). It was common practice during all periods for Rhenish potters to create false arms which had no heraldic significance (Thwaite 1973:257–258), but medallion forms became increasingly degenerate after around 1660 (Noël Hume 1958:440–441). Both the inauthenticity and simplicity of the Monte Cristi heraldic medallions and their careful, detailed rendering suggest that they were made sometime in the middle part of the 17th century.

Conclusion

While answers to some of the questions regarding the Monte Cristi Rhenish stoneware have gradually become apparent, other problems and issues are still unresolved. For example, the collection was probably produced in Frechen in the mid-17th century, a relative date based upon the style of the molded decoration and the approximate reconstructed shape of the vessels. Unfor-

tunately, none of the Monte Cristi medallions have dates incorporated into their designs, a practice which Rhenish potters occasionally employed (Thwaite 1973), so a more absolute date will be difficult to determine. Similarly, the intended destination of the stoneware is also unknown. Rhenish stoneware was exported to locations all over the world throughout the 17th century, so it is impossible to assign a specific destination for this particular cargo. The Monte Cristi pipes, however, were almost certainly intended for the eastern seaboard of North America (Hall 1996), a destination which could have been entirely consistent with the stoneware. Also, since no intact bottles have yet been excavated from the site, no trace of any liquid commodity which was being transported inside has been preserved. Interestingly, no stoppers or lids of any kind have yet been recovered.

The presence of this assemblage on the wreck site, however, does seem to lend weight to the theory that the Monte Cristi ship was in Dutch hands rather than English at the time it sank. Although Rhenish stoneware was popular in England during this period, it was usually the Dutch who carried it as an export cargo (Stanbury 1974; Green 1977). Rhenish stoneware vessels frequently appear on shipwreck sites of many nationalities, but a large quantity of

Rhenish stoneware carried as cargo was generally characteristic of the Dutch. Although only a collection of fragments, the Monte Cristi Rhenish stoneware assemblage is continuing to contribute both to the understanding of the Monte Cristi shipwreck and to the body of knowledge surrounding the production and export of Rhenish stoneware in the 17th century.

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PAUL MARDIKIAN

The Conservation of Two Composite Objects from the Confederate Raider *Alabama* (1864)

Introduction

Dealing with composite objects from marine sites has always been considered an awkward task by conservators because of the technical difficulty in coping with different materials at the same time according to their own nature (Strang 1983; Hawley 1984; Mardikian and David 1996). Emphasis is often given to the most notorious composite, metal-wood, but the combinations are numerous and so are the problems (MacLeod 1987b). For a number of years, the only option to the composite problem was to consider how and not if the object could be dismantled in order to stabilize its different materials separately. In many cases, however, this method has proven to produce a deadlock as many of these objects were not originally designed to be dismantled. The dilemma fluctuates between the real interest in separating the different constituents for their proper understanding and treatment and the inherent violation of the integrity of the artifact as well as the aftereffects of what sometimes sounds like dissection (MacLeod et al. 1993; Mardikian 1997). Although composite objects and structures are common to all shipwrecks, the presence of complex composite objects increases drastically for historical periods and more precisely for 19th- and 20th-century wreck sites.

Discovery in the French territorial waters of the CSS *Alabama* (sunk off Cherbourg on 19 June 1864) by the French Navy minesweeper *Circé* in October 1984 has led to the creation of the French-American CSS *Alabama* Association presided over by Ulane Bonnel and to several successful archaeological campaigns headed by Capt. Max Guérout. Since 1993, the

Archéolyse laboratory has been required and honored to conserve several objects from the CSS *Alabama* for the United States of America and still has important artifacts undergoing treatment at the moment. This paper presents a case study in which a pair of flush toilets made of a decorated white china bowl, lead, brass, cast iron, and wood, and a porthole made of two different sorts of wood, lead, brass, copper, fabric, and glass were successfully stabilized and restored. Following a review of the state of preservation of each artifact, different options are discussed and an ethical operating procedure is proposed respecting both the integrity of the different materials present and the requirements of the archaeological investigation.

Case Study Number One: Commode ALS 34

When the two flush toilets (ALS 34 and ALS 65) were retrieved in 1990 and 1993 from the wreck site, they were kept in tap water until the decision to ship them to the lab was made in 1993. The different components were fused together by corrosion products. Brown concretions completely covered the metallic elements, especially the cast-iron parts at the back. Shells and brown seaweed were encrusted almost everywhere. The overall state of preservation of these two objects was so poor that any inappropriate manipulation could affect them. Cautious handling was necessary at all times to avoid damage to the fragile remains of the cast-iron base which had suffered intensive graphitization due to galvanic corrosion with brass and lead.

Commode ALS 34 (Figure 1, left) was the first to be treated. The china was found to be broken in one conchoidal fragment and stained with iron salts. However, the blue printed patterns were still visible. The lead envelope was partially missing, highly mineralized, and very thin. The lead rim which normally holds the upper part of the china bowl in place had nearly disappeared. The remaining lead covered only a few square centimeters contrary to that of the other commode (ALS 65) which was perfectly



FIGURE 1. Two commodes before conservation treatment. Left, ALS 34 and right, ALS 65. (Photo by O. Pohn, Archéolyse.)

preserved despite some buckling on top. This important feature explains why it was decided to dismantle this commode and treat the other one as a whole. The initial request of the archaeologist was to separate the different parts of one commode—if possible and as safely as possible—in order to study its technology. As the surface of the lead rim was reduced to a minimum, it was possible to unfold it without damage and to replace it after treatment. The removal of the china bowl was possible by unscrewing the two brass bolts on the back of the toilet. After dissolution of the carbonated remnants with a 10% weight per volume (w/v) citric acid solution, these fastenings were removed safely by using a lubricant to avoid jamming the screw thread.

Treating the China Bowl after Separation

The china bowl was removed from its cone-shaped lead envelope. The sludge on the back of the ceramic was washed with tap water, and the biological incrustations on the decorated side were removed mechanically with a scalpel and a

Cavitron ultrasonic dental scaler. After a series of tests, the iron stains were removed by immersing the ceramic in a 10% (w/v) citric acid solution at room temperature for 1 week followed by intensive rinsing in hot water (approximately 50°C) for a period of 2 weeks. Thanks to this procedure, the bowl again had a clean, shiny appearance. The letters NB imprinted on the reverse side in the clay paste under the glaze were also discovered after treatment.

Treating the Rest of the Object

The internal view of the lead envelope after the bowl was removed showed evidence of anaerobic-environment-promoting lead sulfides characterized by a black and muddy deposit and the absence of concretions. The rest of the object was cleaned by using electrolysis to respect the lead and brass in conjunction. A good contact between the different parts was carefully secured and checked with a voltmeter to insure that the brass stop valve connected to the flush system would not be isolated by corrosion products or tightening and would respond correctly to

the treatment. A stainless steel mesh anode was placed around the object. Electrolysis was conducted during 2 weeks in a 1% (w/v) sodium hydroxide solution in tap water at an average potential of 1.00 volts vs. normal hydrogen electrode (NHE) to remove the carbonated concretions covering the object and disengage the different parts. This potential was chosen to counteract the overpotential developed by lead during polarization and to achieve a proper cleansing effect. However, periodic adjustments had to be made until the stabilized potential was reached. In fact, hydrogen evolution had to be reduced to a minimum during this treatment. After this electrolytic cleansing, the different elements were easily disconnected for a classical dechlorination treatment. Examination established that the lead cone was welded to a brass sheet which was secured with five brass bolts to the cubic lead base containing the brass valve. A white, hard portland was still in place to provide an effec-

tive seal and imperviousness between these two parts.

Case Study Number Two: Commode ALS 65

The restoration of the first toilet (ALS 34) revealed the minute details of the commode's construction and fittings. The data provided on the reactions of the different materials during restoration of the first toilet were applied to the conservation of the second, better preserved commode (ALS 65). Contrary to the first commode, ALS 65 still had the cast iron base which had been preserved as two separate pieces (Figure 1, right; Figure 2). The lead was sound despite some buckling on top of the rim. The voluminous concretions on the cast-iron elements resulted from the severe corrosion suffered by this material. In order to maintain the integrity of the object, it was decided to reject the option of separating the ceramic bowl from its lead

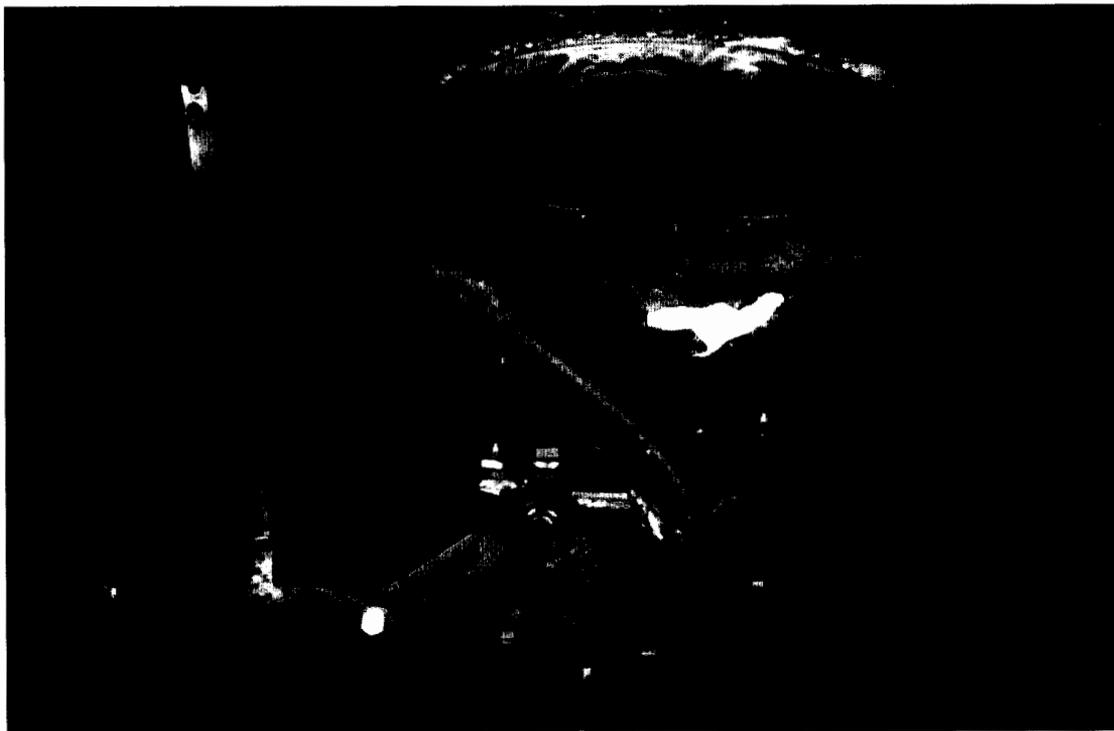


FIGURE 2. Commode ALS 65 after treatment and reassembly. (Photo by O. Pohu, Archéolyse.)

envelope. Rather, conservators elected to clean and stabilize the cubic lead base and the remains of cast iron simultaneously because numerous aspects of a dismantling were judged too risky for the cast iron despite the presence of five brass bolts.

Treating the Ceramic Bowl and Its Lead Envelope

The ceramic bowl was mechanically cleaned with a Cavitron, and the iron stains were removed using a swab of cotton with 10% volume per volume (v/v) hydrochloric acid on wet ceramic to avoid penetration. Instead of using sodium hydroxide as an electrolyte to clean the lead envelope by electrolysis, it was decided to use a neutral solution of 2% (w/v) trisodium citrate to prevent any alkaline attack of the lead glaze and the subsequent opacity of the ceramic. This treatment was conducted in a stirred solution for 1 week at an average potential of -0.70 volts vs. normal hydrogen electrode (NHE). At the end of this process, it was possible to remove large patches of concretions. Finally, the object was thoroughly cleaned with a soft brush and rinsed.

Mechanical Cleansing of the Composite Cast-Iron and Brass Counterweight

The difference between the original surface of the cast iron and the corrosion products was hardly visible. A magnet, or a small metal detector, was used to identify the two materials. Broken shells and other foreign materials were also a good reference to locate the original surface of the metal. The brass screw nut was removed, and the cast iron was chemically stabilized by immersion in a 1% (w/v) sodium hydroxide solution renewed until the rate of chlorides detected was reduced to a minimum. A higher concentration of sodium hydroxide was found to be dangerous to fragile graphitized cast-iron artifacts such as this one. After this treatment, the cast iron was thoroughly rinsed and dried over a 48-hour period in a climatized chamber and then consolidated under vacuum in a 20% (v/v)

PB.48 N toluene solution. Researchers noted several emergency repairs, probably due to fatigue-failure of the brass flush system. The cubic lead part and its cast-iron fragment were mechanically cleaned and then immersed in a 1% (w/v) sodium hydroxide solution. The lead cube was cathodically protected during the chloride removal from the cast iron as lead is prone to dissolution in strong alkaline solutions.

A small wood fragment of the planking was still stuck to a brass screw originally securing the commode on the floor. This little piece of pine was easily removed and treated by classical methods (PEG 400 at 25% v/v) followed by freeze-drying. The different elements of the commode were reassembled after classical protections and finishing treatment (Figure 2).

Case Study Number Three: Porthole ALS 64

This composite porthole (ALS 64) was retrieved from the *Alabama* in 1993. It is made of wood, lead, brass, copper, fabric, and glass (Figures 3 and 4). The two species of wood are oak (*Quercus* sp.) for the ribs and ash (*Fraxinus* sp.) for the planking. This very unusual object could be considered as an inherent part of the ship and could obviously not be dismantled without damage. Its treatment had to be done as one object or not at all.

The three basic questions for its conservation were (1) how to cope with the copper chlorides from the brass sleeve, (2) how to clean the wooden and the metallic parts, and (3) how to stabilize the wood.

The most important problem was that of the copper chlorides that would normally have been extracted from an object made of copper alone by traditional methods involving soaking in alkaline solutions (MacLeod 1987a). However, the presence of wood on the object constituted a categorical contraindication since alkalis degrade wood by reducing the chain length of cellulose. This breakdown could have led to a material impossible to stabilize and to a subsequent collapse of the wood structure. After the mechanical cleaning of the wooden parts using the Cavitron, it became apparent that the only com-

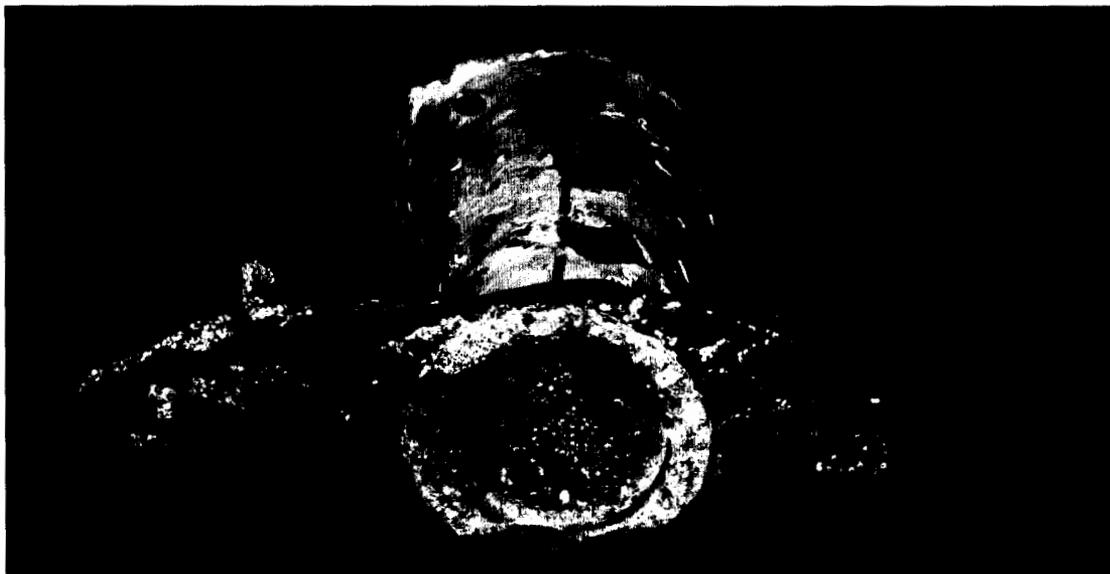


FIGURE 3. Porthole ALS 64 before treatment. (Photo by O. Pohn, Archéolyse.)

promise would be to use three complementary methods to remove or neutralize as many chlorides as possible.

The first step consisted of brushing the brass elements with a 10% (w/v) solution of citric acid inhibited with a 2% thiourea to remove their carbonated remnants and to dissolve the copper chlorides close to the surface. This mixture was also used on the lead parts.

Secondly, the driving force of electrolysis in a 2% (w/v) trisodium citrate electrolyte was used to improve the extraction of the undesirable copper chlorides. The solution was constantly stirred and heated to 40°C for 1 month. At the end of this period, most of the few accessible copper chlorides were assumed to have been released in the washing solution. Close monitoring of this electrochemical treatment was to be done every day to avoid any increase of pH near the wood surface. According to Pourbaix's diagrams, it was determined the cathodic potential should be maintained between -0.10 and -0.20 volts vs. normal hydrogen electrode (NHE).

Thirdly, after being thoroughly rinsed, the object was placed in a 1% (w/v) bath of benzotriazole agitated and heated to approximately 60°C for 24 hours. The porthole was

thoroughly rinsed once again in tepid water and placed at room temperature for a 9-month period in a solution of PEG 200 at 15% (v/v) with a suitable corrosion inhibitor to prevent lead corrosion in PEG (Cook 1984; Cook et al. 1984; Selwyn et al. 1993). After that, the object was finally rinsed and then frozen at -21°C for 72 hours. No visible change occurred on the different materials during the impregnation and the freezing process.

For 4 weeks, this composite object was vacuum freeze-dried. A few small cracks appeared at the beginning of the process but disappeared when stored at 60% relative humidity to equilibrate after sublimation. Tridimensional measurements with pins have shown that the wood dimensions were very well preserved by this conservation process. Since the completion of this treatment in 1995, the object's stability has been continually observed and evaluated according to annual variations of humidity. The two types of wood look good and seem sound and dry to touch at all relative humidity readings. The bull's eye has not shown any signs of deterioration nor has the lead envelope. The internal side of the brass sleeve did not show signs of chlorides. However, recently a few

small white droplets have been observed at high relative humidity on the front of the porthole at the interface between the external part of the brass sleeve and the white portland used for tightening the different elements. Since the white portland was analyzed as being made of a lead carbonate mixture, it is possible to draw a link between this phenomenon and the nature of the portland. Further investigation is needed. Because a fraction of chlorides could still be trapped in the matrix of this complex object, it is necessary to ensure it a proper storage environment: 45% relative humidity should be considered as a maximum authorized rate at 20–22°C. The storage area should be free of organic vapors since they are known to interfere with lead conservation. The contribution of preventive conservation is a fundamental piece of the puzzle and should be regarded as an inherent part of the conservation process.

Conclusion

The major objective of this paper is to show that despite the lack of research and accumulated

knowledge in this very specific field of conservation, it was possible to offer an acceptable alternative to the systematic dismantling of composite objects. It has been shown how two identical objects (commodes ALS 34 and ALS 65) may require different conservation methods as a result of their state of preservation in order to assure their proper treatment and to respect their technological integrity. Although much research is needed in this field and the treatment used on these CSS *Alabama* artifacts is not yet the perfect answer to the composite problem, the treatments discussed here are on the right track. Global methods for the treatment of composite objects retrieved from the sea appear to be on the horizon, and the composite challenge can soon be met successfully.

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FIGURE 4. Porthole ALS 64 after treatment. (Photo by P. Mardikian, Archéolyse.)

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Preliminary Report on the Staved Container Remains from the La Salle Shipwreck *La Belle*

Introduction

In 1684, the French explorer Robert Cavelier, Sieur de La Salle, departed France with four ships in an attempt to establish a colony at the mouth of the Mississippi River. He ended up in Matagorda Bay, Texas, where his struggling colony would end in failure. The failure was due partly to the loss of the explorer's last surviving ship, *La Belle*, a small, exploratory *barque longue* which ran aground near Matagorda Peninsula in February 1686. At the time of its loss, *La Belle* was heavily laden with trade goods, weaponry, and other supplies. Despite salvage attempts by both the French and Spanish, much of *La Belle's* cargo survived the ensuing centuries intact and in remarkable condition.

In the summer of 1995, a team of Texas Historical Commission archaeologists discovered and began limited excavation of *La Belle* (Arnold et al. 1996). During the 1995 season, four reasonably whole casks were identified, stacked neatly in a row. There were also numerous examples of partially articulated casks, as well as many loose, scattered staves and head pieces (Meide 1995).

In 1996, the Texas Historical Commission began the La Salle Shipwreck Project, a multimillion dollar excavation employing a cofferdam to pump the site dry for archaeologists to fully recover the shipwreck. Lying on the starboard side, the hull remains were divided by three athwartships bulkheads into two main storage holds. Both the fore and aft holds were fully loaded with supplies stored in boxes, *tonneaux* (casks), and *barriques* (casks containing liquid). So far, the remains of at least 84 casks of various types and sizes have been identified and recovered from the shipwreck. Many of these were mostly or partially intact, often with their

contents in situ. This excavation will certainly recover thousands of staved container components, which will undergo conservation at the Texas A&M University's Conservation Research Laboratory. This study is preliminary as most of the data herein is based on field recording. While much laboratory analysis remains to be done, a significant amount of information has been generated regarding the condition, form, contents, and lading of *La Belle's* staved containers.

Condition and Recovery Techniques

The casks on *La Belle* were discovered in remarkable condition and may represent the largest sample of intact casks from any known shipwreck site. Even though casks from underwater sites are invariably better preserved than those from land sites, it is still rare to find completely intact specimens. Out of the estimated 85 casks recovered during the 1979 season from *San Juan*, the 16th-century Basque whaler excavated by Parks Canada, only one or two were observed whole with all hoops intact (Ross 1985:11). Though a number of partially complete whale oil casks were recovered from *San Juan*, almost all of them were collapsed, with little or no hoop remains. They consistently followed a distinct pattern of three-layer deposition—the head pieces sandwiched between the upper and lower staves (Bradley 1984:35). On other underwater sites such as the 18th-century Yorktown cofferdam wreck *Betsy*, staves were well preserved but the hoops had deteriorated, resulting in “staves splayed apart slightly giving them the overall appearance of having been exploded open” (Weinstein 1992:61). In most cases on the Yorktown wreck, the heads were displaced as well, falling either inside or next to the cask remains.

In the early stages of the 1996 La Salle Shipwreck excavation, staved containers uncovered were in relatively poor condition. Loose staves were scattered across the site just under the sediment surface, and several heavily concreted in

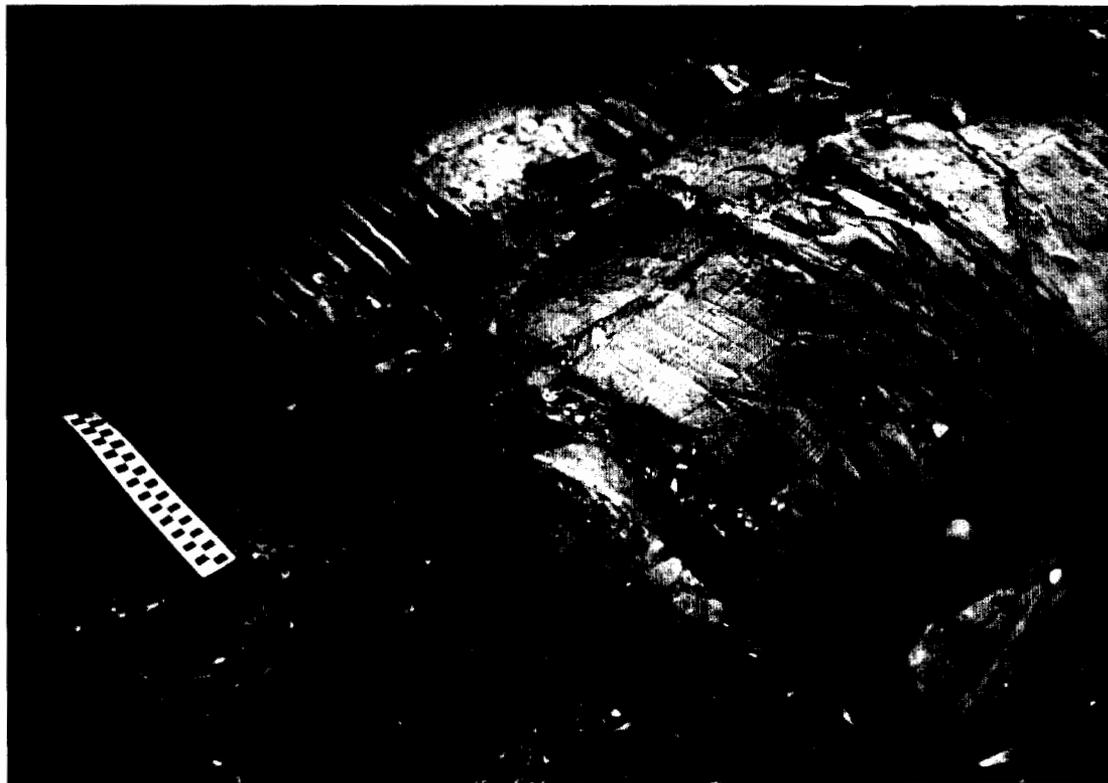


FIGURE 1. Cask Features 63 and 29, two storage *tonneaux* that were part of a row of four intact casks first observed underwater during the 1995 season. (Photo by Chuck Meide.)

situ cask features protruded above the sediment. In the case of articulated remains, often only the lower section of staves remained. Many of these remains were heavily concreted, with little wood remaining. These poorly preserved specimens were located in the upper part of the shipwreck and were therefore only partially covered by the muddy sediments of the bay. As the excavation proceeded, however, it became apparent that organic remains deeper in the wreck had been protected by the anaerobic environment of clay and mud, and with deeper levels more intact casks were revealed.

Some casks, such as those seen in Figure 1, were wholly intact and retained their original barrel shape. Often this retention was due to the concreted contents which made the container a solid mass. The two casks in Figure 1 had heavily concreted contents and retained all of

their staves and head pieces and most if not all of their original wooden hoops. Both were solid enough to be outfitted with nylon straps and removed from the site by crane. This recovery technique may seem crude but was used with a high degree of success, and none of the highly concreted casks sustained any damage. Other specimens were also complete but very fragile. Many of these had soft contents, such as gunpowder, and were partially crushed and somewhat misshapen. Still, for the most part, all of the casks deeper in the hold were complete, partially or wholly sealed containers with most or all of their hoops in place. Some of the most fragile specimens have been jacketed with plaster of Paris and removed by hand in one piece for laboratory excavation. Others were recorded, taken apart stave by stave, and their contents excavated on-site.

Cask Form and Contents

After the 1995 season in which only four intact staved containers were observed, a typical *La Belle* cask was reconstructed (Figure 2). Though the 1996–1997 excavation has uncovered several different variations, the 1995 reconstruction remains a good example of the general form and construction of these 17th-century French casks. For the most part, the casks from *La Belle* were composed entirely of organic materials without metal fasteners or hoops. The exception was one type of cask, the largest, which had iron hoops. The casks from *La Belle* typically consisted of 15–20 staves, held together by 8–24 split wooden hoops. The split wooden hoops, with unmodified edges, were usually arranged in two groups at either end of the cask. Hoop joins were fastened to each other with

wickerlike rush binding and for the most part did not appear to be notched. The individual hoops on all but the smallest casks averaged 2.7 cm in width, narrowing at the joins to 1.5 cm.

Staves varied in length from ca. 20 to 100 cm depending on the size of the cask. Croze grooves were present at either end of the inner surface of the staves, and a single double-grooved specimen has been noted, indicating re-use. Stave edges or joints were beveled to the interior. Some of the casks originally contained liquid, as evidenced by bung holes and bungs present on some staves. Bungs ranged from relatively flat, tapered discs to longer, rather narrow plugs with slightly tapered sides. Smaller sample holes, sometime plugged with small narrow pegs, were also present on some staves.

Cask heads were made of one to six head pieces. No reinforcements were observed on any of the staved containers except for a single shot cask where possibly two reinforcements were noted. There was also no evidence of head piece dowels. This lack of typical staved container structural features is somewhat enigmatic as these two methods were commonly used to keep composite heads in place. Their absence may represent a previously unknown coopering technology (Lester Ross 1997, pers. comm.).

Preliminary wood analysis, conducted at Texas A&M University, has identified the staves as white oak (*Quercus* sp.). The cellular structure of white oak makes this wood exceptionally impermeable, and it was often used in tight and slack cask construction (Amy Mitchell 1997, pers. comm.). As this analysis is in its preliminary phase, many of the container components remain to be tested for wood species.

Markings

Several different markings have been observed on the outer surfaces of both head pieces and staves. One such mark from a cask fragment recovered in 1995 may represent No. 5 (Figure 3, top). One stave appeared to be inscribed at the booge with the letters DIS. At this point in the excavation, most of these cask markings remain unexplained, likely representing shippers'

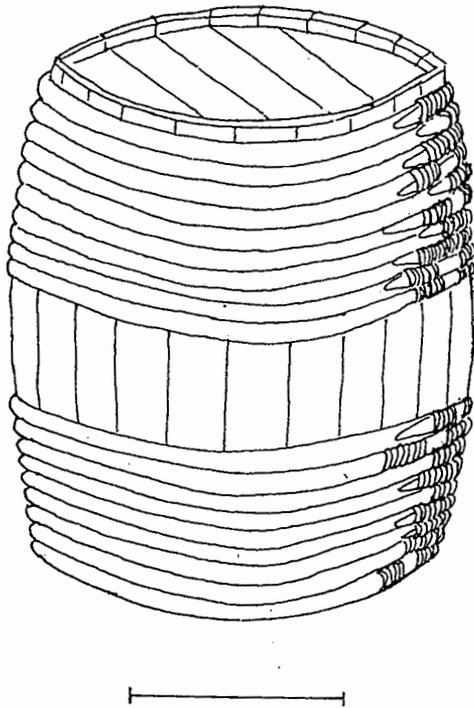


FIGURE 2. Reconstruction of a typical *La Belle* cask, based on 1995 observations of a storage *tonneau*, Cask Feature 63. The 1996–1997 season uncovered a variety of cask forms and sizes. Scale represents 30 cm. (Illustration by Chuck Meide.)

marks denoting cask contents or ownership. One series of markings has been identified, however. Casks containing gunpowder were consistently marked at the head with circular designs (Figure 3, bottom). These markings varied, but were always circular in nature. Single circles, half circles, double intersecting circles, multiple separate circles, and groups of circles or half circles with a separate straight line have all been recorded on the head pieces of powder casks. Each powder cask usually had markings on both heads.

Variations of Contents and Form

Translations of journals written by survivors of the colony provide an account of what types of cargo were being carried by *La Belle* on its final voyage: "4800 livres of dried meat, as well as grease, vinegar, salt, oil, and flour, and six casks of wine . . . all the trade goods; powder, shot . . . [and] tools . . ." (Weddle 1991:29). Different styles of casks have been found representing most of the above categories. There was quite a variety of sizes and characteristics of the staved containers from *La Belle*, and these differences seemed to be related to the intended contents for each type of container. The following section provides an overview of some of the general types of casks and their contents, starting with the smallest and working up to the largest.

La Belle's smallest cask was also one of the more interesting and delicately crafted containers on the vessel (Figure 4). Cask Feature 20 (artifact #3730) was apparently a small *barrique* that contained wine or brandy, as its inner surfaces were stained a dark purplish color. This cask was approximately 19 cm in length and 11 cm across at the head. Each head was made of single piece, and a small, tapered, disklike bung was present in one of the staves at the booge. This cask was associated with the only articulated human remains found on-site, a skeleton uncovered in the bow amid heavy coils of anchor rope (Figure 4, pelvis and coccyx visible in lower left quadrant). It is not known if this sailor was one of those who died of thirst before

La Belle ran aground, or if he was below deck, perhaps drinking from this wine cask, when the ship wrecked and sealed his doom.

The next category of staved container was the shot cask. *La Belle* carried an immense amount of lead shot ranging in size from birdshot to musket balls to swivel-gun shot. These *tonneaux* had to be relatively small due to the weight of the lead (intact shot casks require at least two archaeologists to carry). The average shot cask was made of staves about 35 cm in length and 6–10 cm wide. The width at the head was approximately 18 cm. Some of the heads were composed of two pieces while others were single pieces. Bungholes with bungs in place in the center of the head have been noted on a few of the shot casks. One and possibly two head reinforcements have been noted on one of the shot casks. Reinforcements could not have been used on all of the shot casks as their placement would have interfered with the head bungs. These casks also had a unique hoop pattern: four

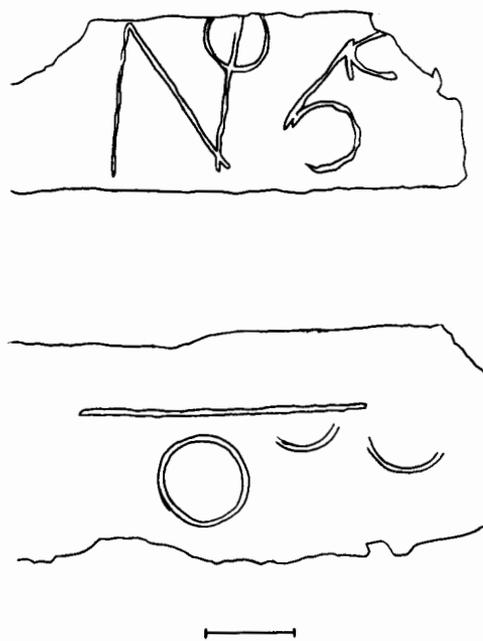


FIGURE 3. Markings on cask staves and head pieces: a, possible No. 5 on specimen recovered during the 1995 season; b, circular marks on a head piece, signifying a gunpowder cask. Scale represents 5 cm. (Illustration by Chuck Meide.)

sets of paired hoops spread evenly across the entire cask (one at each end and two in the middle). Present on the interior surface of shot cask staves and head pieces were distinctive circular impressions or dimples made from the weight of the lead balls. These casks were stowed low in the ship, mostly in two groups equidistant from the keelson, and obviously helped to serve as ballast. They were generally arranged on their sides in athwartships rows, but the anomalous position of some of these casks suggested that, due to their small size, they were used to fill the empty space between larger casks and therefore maximize storage efficiency.

One of the most common types of casks excavated was the gunpowder cask. These casks were scattered within the aft hold. Due to the soft nature of their contents, many of these powder casks were partially crushed and deformed by site formation processes, though most retained all of their features and still contained powder. Gunpowder casks varied in size, with staves ranging in length from 40 to 55 cm and head widths ranging from 30 to 40 cm. All of the powder casks had two sets of eight hoops arranged at either end of the container. As stated previously, all of the gunpowder cask heads were marked with circular designs denoting contents (Figure 3, bottom). One cask containing a thick black tar or pitch, still pungent after 3 centuries, was about the same size as the gunpowder casks.

Another class of *La Belle* cask was the large *tonneau* used to store nonorganic cargo such as trade goods and tools. This type was first observed underwater in the 1995 season, and examples can be seen in Figure 1. Three of these *tonneaux* were observed laid out on their sides in a transverse row just aft of the forward bulkhead. This type of cask is reconstructed in Figure 2. This *tonneau* stood about 70 cm tall and measured about 50 cm across at the head and 60 cm at the boogie. The composite heads comprised five to six pieces. The staves were held together by 20–26 split wooden hoops arranged in two sets, 24–27 cm wide, at either end. These casks, meant to store dry goods, lacked bung holes.



FIGURE 4. Cask Feature 20, a small wine or brandy *barrique*, 20 cm long and 11 cm at the head. Found in direct association with human remains—coccyx and pelvis visible in lower left quadrant. (Photo by Paul Jordan.)

Many of these *tonneaux* apparently held iron tools or trade goods, and some were heavily concreted. Several, including those seen in Figure 1, had well-preserved wooden outer surfaces relatively free of concretion but had heavily concreted contents which helped them retain their original barrel shape. Another specimen, when partially disassembled in situ, was full of iron ax heads with little or no concretion. It is not clear if these were stored for Native American trade or for use at the colony, but they may have been intended for both. In this same area in the forward hold, there were also a few large, solid sections of deteriorated trade good casks. One in particular provided an interesting cross-section of the *tonneau*. This cross-section revealed the method of packing small items in these storage

casks. Partitions could be seen dividing the cask into separate compartments for trade goods such as strings of glass beads, small mirrors, brass pins, and knives. Other partially articulated casks in this area held hundreds of small brass hawk's bells, also intended for trade.

The largest of the casks from *La Belle* were massive *barriques*, found mostly in the forward hold. These casks differed from all of the others not only in size but in hoop type. They appear to have been held together by at least four wide iron hoops. The iron on the exterior was typically heavily concreted. Cask Feature 31, located in the forward hold in the row of three storage *tonneaux*, was an exceptionally well preserved example of this type. It was a full meter in length, with a head diameter of 60 cm and measuring 66 cm across the boogie. It consisted of 19 staves and five head pieces at each end. It had a bung stave with an intact bung. When disassembled on-site, it was found to be empty except for a layer of crystalline substance lining the bottom staves. While this material has yet to be analyzed, it most likely represents the remains of some liquid substance. Not all of these large, iron-hooped casks may have contained liquid. Several were lined with a brown, tacky, pastelike substance that may be food remains.

Other Staved Containers and Coopering Related Artifacts

There was one example of an open-ended staved container. At least two staves from a bucket have been identified. One specimen was a simple, short stave with a croze groove at its bottom end. The second was a bucket-handle stave. It was slightly longer, with its top corners squared off, and had a hole for the handle. No other open-ended staved containers, such as vats or tubs, have been observed.

One interesting artifact related to cooperage was recovered. It was a cooper's long joiner plane used for stave construction. Its body was about 1 m in length. The lower end had a foot that rested on the ground during use. The upper end had two sawhorselike legs (which were mostly deteriorated) so that the tool was angled

up when in use. The body has a beveled hole into which a blade would have fit. There was no blade or concreted remains present on the tool when found.

When making staves, the cooper would first make planks by splitting logs longitudinally and then use flat-edged axes to dress the edges and inner and outer surfaces to fashion the final tapered shape (Ross 1985:17). At that point, the stave edges or joints were planed smooth, using a cooper's plane similar to that recovered from *La Belle*, to create an acute angle from exterior to interior. It is not surprising that La Salle would have brought coopers and therefore coopering tools to the New World; repairing old and constructing new staved containers would be a necessary and ongoing task for the fledgling colony.

The cooper's plane from *La Belle* was found in the pump well along with several loose staves and head pieces. It has been suggested that the ship's carpenter would likely have been responsible for maintaining the pump, and he therefore may have used the well for storage of his personal tools (Fred Hocker 1997, pers. comm.). Though the well would have normally been kept clear of foreign objects, it is certainly possible that due to the immense amount of cargo loaded for this voyage, personal storage space outside the pump well was extremely limited (Tom Oertling 1997, pers. comm.).

Conclusion

La Belle carried a large cargo stored in a wide variety of boxes, *tonneaux*, and *barriques* on its final voyage. More than 84 distinct casks have been recovered by the Texas Historical Commission during the 1996–1997 season, and most of these were intact and wholly or partially sealed. Several distinct cask types have already been identified, varying in size and shape in relation to their intended contents. Examples of different kinds of staved containers encountered thus far include the remains of a staved bucket, a small wine cask, small shot casks, numerous gunpowder casks, a tar or pitch cask, large storage casks containing tools and trade items, and very large

storage casks containing liquids and foodstuffs.

Construction details were, for the most part, similar for the different types of casks. In general, *La Belle* casks were made of wooden staves and head pieces held in place by 8–24 split wooden hoops. Only one type of cask, the largest, had iron rather than wooden hoops. Few head reinforcements have been observed. There have been numerous examples of what were most likely shippers' marks on both staves and head pieces.

The research thus far is based almost solely on field recording. A monumental task awaits Texas Historical Commission researchers who will eventually catalogue and analyze thousands of staved container remains. This sample of intact casks, possibly the largest and most diverse collection in existence, will provide a clearer understanding of 17th-century colonial French exploration and trade and will provide a first-hand account of how trade goods and colonization supplies were packaged, stowed, and shipped.

ACKNOWLEDGMENTS

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The Development of the Deck Light during the Nineteenth Century

Introduction

How to provide light to the dark recesses of a ship's hold has been a problem shipwrights and captains have been trying to solve for thousands of years. Open flame illuminants, such as oil lamps or candles, were considered the primary solution since they were both portable and convenient. However, not only did this type of illumination create messes of oil or wax drippings, they were also a fire hazard. The alternative, then, was an outside source of lighting, usually the sun.

The first natural lighting devices were probably no more than open cargo and access hatches. After A.D. 1505–1510, natural lighting of between-deck spaces received a boost with the invention of the gunport which led to the development of portholes and stern lights. The next step to better natural lighting was better glass making techniques marked by the dates 1688 and 1773. In 1688, the French developed a method for casting glass that produced thick, flat sheets. These sheets were then ground into panes which were larger and clearer than their mica predecessors. In 1773, English manufacturers began producing a thin, flat window glass which was easily obtained and relatively inexpensive. These characteristics helped encourage the use of natural light (Lavery 1988:176–177).

One of the most innovative developments in natural lighting appeared in the early 19th century in the form of the deck light. The deck light consisted of a piece of thick glass placed into a hole in the deck or side of the hull. The glass or lens was held in place with either a metal or wooden frame set onto rabbets or a collar made of thin sheet brass or copper tacked to the planking. Then the entire assembly was

sealed with a cement to prevent water from penetrating the hold. This innovation was introduced in 1807 when Apsley Pellatt of London received a patent for what he called the Illuminator.

The Illuminator

Pellatt described the Illuminator as a solid piece of glass with a circular flat base and a convex top, or basically a large lens approximately 5 in. (12.7 cm) in diameter and 1 in. (2.54 cm) thick in the middle. The semi-spherical glass was placed convex side up into a square or circular frame made of wood or metal then sealed with glazier's putty or other type of cement. This frame/lens assembly was eventually set into a rabbeted deck or side plank (Pellatt 1807:321–323).

The convex side of the lens was intended to protrude slightly above the plank in order to catch the rays of light from the sun. Pellatt warned that one side of the lens should remain unpolished in order to prevent it from becoming a "burning glass" when the sun's rays were concentrated through it. He even suggested placing hinges on the frames so that they might be opened to admit air; however, this idea was rarely utilized before 1818. His vision was that the Illuminator would be used to admit sunlight into the internal parts of ships by placing them in ports, scuttles, decks, and skylights (Pellatt 1807:321–323).

Pellatt's innovation was not called the Illuminator for long. By 1812, the assembly was referred to as the Patent-light since it had been officially patented. Also by that year, although the general assembly was still being used, the wooden/metal frame was often omitted. Instead, the patented lens was placed (still convex side up) directly onto the rabbet. Then a brass or copper collar was placed around the lens and tacked to the deck to keep the lens in place (Figure 1). This arrangement was often nicknamed the "bull's-eye light" since the shape of the lens and the surrounding metal rim was reminiscent of a very large eye (Crisman

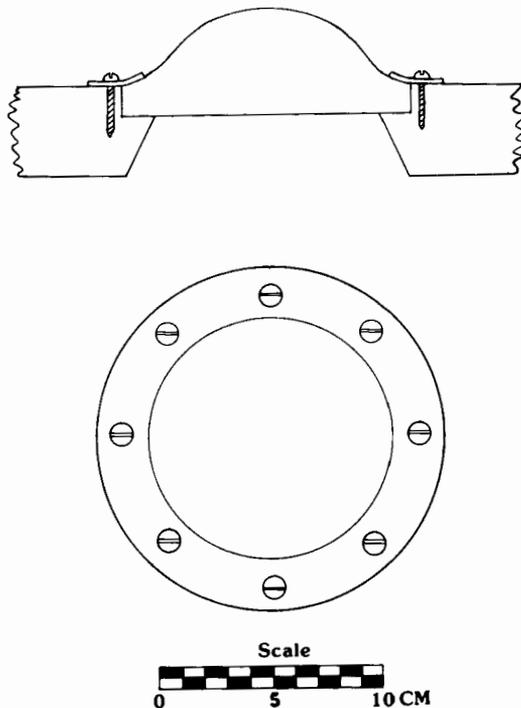


FIGURE 1. Sketch of a Patent-light with a copper collar.

1992:50; Vlierman 1994:319). Another change in the Patent-light appeared around 1818. Certain ships had deck lights that had inverted the lens so the convex side was placed down into the planking. This arrangement allowed the fixture to lay flush with the deck. It was a great improvement over the protruding lenses which often made footing tricky for deck hands (Preston 1818:358; Crisman 1992:50).

As with many new innovations, the military was the first to utilize the Illuminator/Patent-light. The Royal Navy began placing these lenses into gunport lids as early as 1809 alongside the ventilation scuttles that had been approved earlier in 1778–1789. Soon after, Illuminators were placed in English warships as side-lights and deck lights (Lavery 1987:140).

The young United States Navy soon followed suit. In the year 1814, at least three U.S. warships were fitted with Patent-lights as deck lights: the brigs *Jefferson* and *Jones* and the row

galley *Allen*. During excavations of the U.S. brig *Jefferson*, built by Henry Eckford on Lake Ontario, two pale green glass lenses and a copper collar used to keep the lens in the deck were recovered in the vicinity of the main mast. The lenses were very near in shape and size to Pellatt's description. They were flat on one side, convex on the other, and measured $5\frac{3}{4}$ in. (14.6 cm) in diameter and $1\frac{3}{4}$ in. (4.4 cm) thick. Wear on the lenses indicated they were installed convex side up into circular openings cut into the planks and cemented in place while the copper collar was fastened to the planks with brass tacks (Crisman 1992:50).

The *Jefferson* was not the only vessel built on Lake Ontario to use the Patent-light. According to historical documents, the sister ship of *Jefferson*, called *Jones*, was issued six Patent-lights, two of which were used to cast light into the binnacle. Also, in February of 1814, the commander of the lake squadron, Captain Isaac Chauncey, ordered six dozen Patent-lights from his agent in New York City. Since at least three kegs of the lights were delivered to Sackets Harbor that spring, it is probable that several more vessels built that year on Lake Ontario were fitted with Pellatt's invention (Crisman 1992:48–50).

This trend toward the use of Patent-lights on U.S. warships was not limited to the vessels Eckford built. Excavations of the row galley *Allen*, built by Noah Brown on Lake Champlain in the same year, also produced a fragment of a Patent-light (Emery 1995:134). The most likely location for a deck light on a gunboat would be over the magazine in order to minimize the danger of lighting gunpowder with a lantern. Yet any deck light would have been useful on the *Allen* because it provided a sufficient means of illumination with a minimal amount space. The quarters on a gunboat were extremely tight, making effective space utilization a necessity. A deck light could have been mounted on the deck or the side of the hull in order to illuminate the tight spaces below deck, making a bulky lantern unnecessary to carry.

The use of Patent-lights during the 19th century was not exclusive to military vessels. Deck lights, however, were not widely used on merchant or fishing vessels until after 1850. Gloucester schooners began using them in the early 1850s when two or three deck lights lit the hold and two more lit the cabin. Across the Atlantic, off the coast of Flevoland, the Netherlands, fishing and merchant vessel wrecks dated to the late 1900s have produced a large number of lenses. Two examples from Flevoland were the Patent-light type since each was circular with one flat side, one semi-spherical side, and beveled, ground edges. Wear on the glass indicated that these lenses were mounted with the convex portion protruding out of the deck. One, in fact, even had the word *Patent* inscribed on the flat underside (Figure 2a, 2b; Vlierman 1994:322).

From the Patent-light came many other types of deck lights. However, these variations mostly

involved changes in the shape of the lens, and all can be grouped under the term *fixed deck lights*. Each lens type developed was represented by examples found on the vessels at Flevoland (Vlierman 1994:322).

Fixed Deck Lights

After the Patent-light was inverted, enabling the entire fixture to lay flush with the deck, a semi-spherical shape was no longer necessary. All that was needed was a flat, thick piece of glass. Several examples of flat lenses were found among the remains at Flevoland. The first was a circular lens with two flat sides. On one side, presumably the side facing up in the deck, was a checkered pattern (Figure 2c). Perhaps this checkered pattern was an attempt to create a safer deck light for when the smooth surface of a regular glass lens was wet, it became ex-

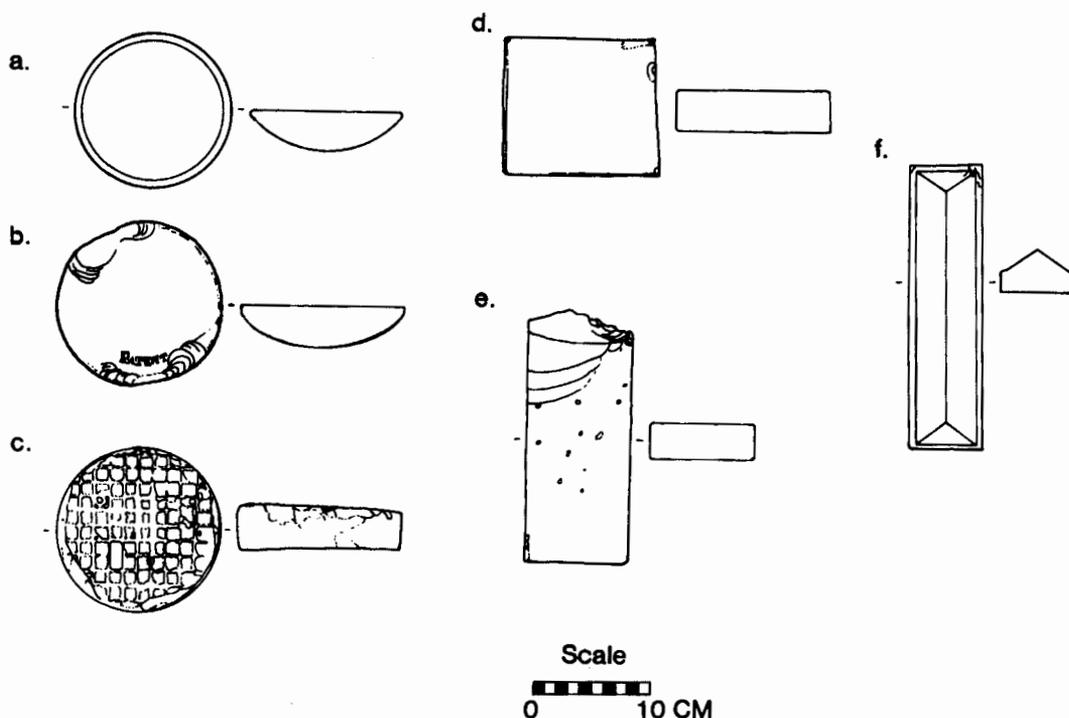


FIGURE 2. Deck-light lenses found on merchant and fishing vessels off the coast of Flevoland, the Netherlands (after Vlierman 1994:320).

tremely slippery. A checkered surface probably gave a sailor more traction in wet conditions (Vlierman 1994:322).

Another flat lens found at Flevoland was square. The square lens was probably developed after shipwrights discovered that a deck light fixture sealed better when it was placed into a single deck plank. Since a square shape fits a single plank more easily than a circular one, square lenses appeared. The square lens in Figure 2d was found in situ on a cargo vessel. The deck light was not only flush with the deck but was snugly placed into one plank (Vlierman 1994:321). If keeping the lens in one deck plank was beneficial, then the best way to increase the size of the lens without risking more leaks was to make it longer instead of wider. This train of logic created the rectangular lens such as the flat one found at Flevoland (Figure 2e). Rectangular lenses were reputed to break less often than square ones. The other rectangular lens found at Flevoland (Figure 2f) had a four-sided prismatic base which represented the next development in deck lighting—the deck prism (Vlierman 1994:322).

Prismatic Deck Lights

In the middle of the 19th century, it was found that faceting the underside of a lens (perhaps first tried on the convex portion of a Patent-light) created a prism which would refract sunlight below decks effectively. The deck prism came in two shapes: one with a rectangular top and an elongated, inverted pyramid base (Figure 2f); and another with a hexagonal top and a base with six triangular faces converging, a point at the distal end.

The most popular of the two was the hexagonal lens. Exactly when this type of deck light came into use is unknown, however. The earliest known example was found on the whaler *Charles W. Morgan* built in 1841. Several hexagonal prisms were located in *Morgan's* deck; each measured 4 in. high, 4 in. across the top, and weighed approximately 3 lb. (Figure 3). Like their predecessors, prisms were set into a rabbet in the deck and held in place by a cop-

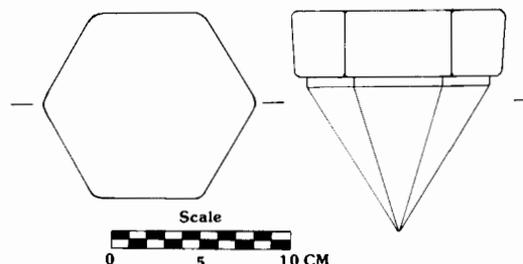


FIGURE 3. Replica of the hexagonal deck prism found on the whaler *Charles W. Morgan*.

per frame screwed into the planking (Leavitt 1973:3, 58).

Deck prisms were, in general, more efficient light sources than previous lens types for two reasons: first, they were able to cast light further into the recesses of the hold; and second, they were effective at catching rays of light even when the sun was low in the sky. In November of 1995, Norm Thomas of the Lawrence Livermore National Laboratory conducted an optical analysis of a replica of one of the deck prisms from the *Charles W. Morgan*. He found that when the sun was at an angle to the lens of less than 38° , the lens reflected the light nearly vertically into the hold. However, when the sun was at an angle greater than 38° to the lens, the prism reflected the sunlight internally and bounced it back into the hold in the general direction of the sun. (Norman Thomas 1995, pers. comm.)

Although not as popular as the hexagonal type of lens, rectangular prisms were still utilized in many 19th-century vessels. During the 1978–1982 restoration of the barque *Elissa* (built in 1877), workers found that at least ten rectangular prisms had been installed in the stern over the officers' quarters. Although of a slightly different shape than the hexagonal prism analyzed by Norm Thomas, rectangular deck lights also caught light and directed it into the hold. In fact, each cabin of the *Elissa* containing a deck light was fitted with a sliding, wooden cover. During sleeping hours, the deck prism could be covered since light coming through the prism from the moon would often keep the officers awake (Tom

Oertling and the Texas Seaport Museum Staff [Galveston] 1996, pers. comm.).

Ventilating Deck Light

In 1818, a branch of deck-lighting technology appeared in the form of the ventilating deck light. In that year, a patent was granted to Grant Preston for an innovation called the Portable Deck-light which built on Pellatt's original idea of combining deck lights with ventilation. Preston suggested that a screw-rim, or a brass or copper tube with interior threading, be placed into the deck as a fixture. A semi-spherical, glass lens would then be fitted, convex side down, into a slightly smaller screw-rim with threading on the outside so it could be twisted into the first one. Finally, a vent with a safety grate was fixed into a threaded collar and mounted below the glass. The lens and the vent were each

made to screw either right or left, so that when the glass is wanted to be taken out for air, it only rests with the person or persons below to take hold of the handles and unscrew it; it may then be hung on a hook, to prevent rolling about (Preston 1819:141).

This form of deck light was praised soon after its introduction by people who tried the light on their vessels. They complimented the design as being easy to use, watertight even in rough weather, and sufficient in providing ventilation in fair weather (Preston 1818:358–360). Yet, evidence suggests that the ventilating deck light was not widely used on seagoing vessels during the 19th century. One of the earliest known examples of Preston's innovation dates to nearly fifty years after its introduction—on the USS *Monitor* built in 1862.

Construction plans for the ironclad USS *Monitor* showed that deck lights were used as the primary source of natural light. There were nine rectangular deck lights in the stern and 16 round deck lights placed in the bow (Peterkin 1985:61). Since the deck of the vessel sat near the waterline, the use of deck lights was logical; the

lights would provide illumination in the ship and still keep out most of the water that was bound to wash over the deck. Although the rectangular deck lights were probably fixed prisms, the round ones seem to be of the Portable Deck-light type. During an early reconnaissance of the vessel, divers located a round, brass-framed deck light. The glass of this fixture appeared flat on top, and the rim was raised above the deck in much the same fashion as in Preston's diagram. Also recovered from the vessel was a deck light cover which was used to protect the light and crew during battle (Watts 1981:32, 100).

Ventilating deck lights were apparently considered a success on the *Monitor* since they were also used on later *Monitor*-class vessels. An account by Alvah Hunter, who served aboard the *Nahant* in 1862–1863, described “two score of dead-lights” or some forty deck lights. They were, Hunter states, circular windows that gave light to the staterooms, the great cabin, the wardroom, and the berth deck. Each light was made of a circular plate of thick glass with a beveled edge. A rubber gasket was placed around the bevel; then the glass was enclosed by a metal frame. Instead of being screwed in and out of place for ventilation, the frame was hinged on one side so it could be opened and closed. It could then be secured into place by a large thumbscrew on the other side. During a battle, the lights were secured in place from below the deck by “hooking a stout hook into an equally stout eyebolt.” The vibration from the guns, however, caused many lights to loosen during battle. Hunter and his crewmates had to tie each hook into its eyebolt with a piece of rope to ensure they remained closed (Hunter 1987:17–18).

According to Hunter, the light produced by these deck lights was pleasing to the eye. He states that as water washed over the deck it made for a

very curious and interesting lighting effect in the rooms beneath. The water twisted about and boiled in the dead-light cavity, and, being more or less charged with air bubbles, the constantly changing shades of green light were a pleasure to study (Hunter 1987:17–18).

The green color of the light Hunter describes suggests that green-colored glass was used in the deck lights, reminiscent of the green lenses used in the *Jefferson* fifty years earlier. To protect the glass, circular deck-light covers were also used on the *Nahant*. These covers were made of two iron plates, each an inch thick, and were placed over the lights when the vessel was going into action (Hunter 1987:17–18).

Although not as popular as the fixed deck lights, the ventilating deck light was in use as late as 1901. In that year, the arctic exploration vessel *Discovery* was fitted with 28 circular deck lights so that each of the lights could be opened from below decks with a screw fitting. In many of the individual cabins, the Portable Deck-light was the only source of natural light and ventilation. The crew of the *Discovery* called the deck lights “ankle-biters” since they sat a good 10–15 cm above the level of the deck, just the right height to catch ankles. While these deck-light/ventilators were a bit taller than Preston proposed in his patent, they seemed to have a similar type of screw/ventilation mechanism (Kevin Robinson 1995, pers. comm.).

Conclusion

In his 1807 patent, Pellatt laid out the basic principle that a glass lens could provide a safe and watertight means for illumination of the hold. This idea soon spread to the military shipyards of England and in short order to the United States, where the deck light was used on warships dating from 1814 to 1868. As with other inventions, the idea spread into the private sector much more slowly. By the middle of the century, however, deck lights were being installed in merchantmen, fishing vessels, and even vessels of exploration. During the 19th century, the deck light changed little from what Pellatt had originally conceived. The only changes came in the shape of the lenses. While it seems several shapes were tested, the most effective appeared to be the prisms. With their ability to refract light into the hold at any time of the day, it is understandable why these types became the

most popular lenses of the time. The combination of illumination and ventilation was exalted as a good idea when Preston introduced the Portable Deck-light in 1818. Yet, the evidence suggests it was not widely utilized by shipwrights except during the Civil War, perhaps because it was a more complicated fixture and therefore more difficult to keep sealed.

Pellatt’s vision of the Illuminator can be considered a success. First, it provided a means of natural lighting for below decks, a fact which likely saved many ships from burning to the water line. Second, it was simple and effective enough to be used in a wide variety of ships for over a century. It can be safely concluded that Pellatt had creatively answered the age-old question of how to bring light into a ship’s hold.

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Is the Chicod Creek Vessel a *Macon*-Class Porter Gunboat?

Introduction

Named after the tributary of the Tar River in Pitt County, North Carolina, where it rests, the Chicod Creek vessel has been under intermittent archaeological investigation since 1973. Researchers believe this vessel is a Confederate *Macon*-class Porter gunboat built during the winter of 1861 in Washington, North Carolina. This paper examines the Chicod Creek vessel, hereafter cited as Chicod, in the context of the vessel's history and archaeology to demonstrate that it is a Porter gunboat.

History

Chicod is an enigma. If it is a steam gunboat, why have archaeologists found no evidence that it ever carried machinery or armament? Historical sources, normally rare for Confederate gunboats, are virtually silent with respect to Chicod. With little information available concerning the wreck, the author cast a broad net over four historical topics—technology, John L. Porter, the Confederate navy, and Washington, North Carolina—in collecting data to establish Chicod's provenience.

History of the Technology

The Civil War found naval architects scrambling to design shallow-draft, steam warships. During the mid-19th century, the United States found itself unable to protect its maritime interests simply because its vessels drew too much water. While screw propulsion seemed the most likely avenue for success, it necessitated a substantial draft hull. Numerous experiments involving multiple screws or submerged paddles ended in disappointment. As a result of these experiments, naval architects believed that shallow-draft, twin-screw vessels would only become

feasible with iron hulls (Canney 1990:87). John W. Griffiths, America's premier clipper designer, begged to differ, and his contribution led to the Porter gunboats.

Griffiths's *Treatise on Marine and Naval Architecture* (1854 [1850]) merely embellished his existing stature as an American maritime architect. In response to predation of American shipping during the 1850s, Griffiths approached the Secretary of the Navy and offered to build an experimental shallow-draft, twin-screw steamer for the Navy. His proposed vessel, the USS *Pawnee*, became the first operational twin-screw warship. Part of the Navy's 1858 sloop construction program, the *Pawnee* was as much iron as wood (Canney 1990:84–87).

History of Chief Naval Constructor John L. Porter

Other than his involvement with the CSS *Virginia*, little information concerning John L. Porter exists in secondary sources. Porter's autobiography remains unpublished, and no one has published a biography. As an assistant naval constructor, Porter submitted a proposal to the Navy Department for a shallow-draft, single-screw sloop, the USS *Seminole*. *Seminole*, *Naragansett*, and *Pawnee* were the experimental shallow-draft members of the 1858 sloop construction program (Canney 1990:82–87). One important premise for interpreting Chicod is that Porter had knowledge of Griffiths's *Treatise* and the *Pawnee*. According to Porter,

I received orders to report to the Washington Navy Yard. . . . I found there the Steamer *Pawnee* and was ordered to fit her out which I did in March, 1861 (Porter in Flanders 1988:11).

History of the Early Confederate Navy

During the first year of the war, Confederates attempted to produce a wide range of wooden and iron-plated gunboats in the Carolina Sounds. As many as four vessels were Porter gunboats (Holcombe 1995:13). Confederates did not refer to wooden gunboats as a particular type or class.

This lack hampers study of early Confederate warships.

In an effort to organize the various construction programs, Robert Holcombe devised a useful paradigm for classifying Confederate gunboats. He grouped vessels according to hull descriptions, motive power, and contract dates. He defined the Porter gunboats as having twin screws and divided the program into three classes based on hull length. Contract dates for the program range from 3 October to 4 November 1861 (Holcombe 1995:13). Holcombe's classifications are

Macon-class: 150-ft. length, 25-ft. beam, 10-ft. depth of hold, 8-ft. draft;

Chattahoochee-class: 130-ft. length, 30-ft. beam, 10-ft. depth of hold, 6-ft. draft;

Escambia-class: 110-ft. length, 18-ft. beam, 10-ft. depth of hold.

This author's current research indicates the Confederacy entered into agreements to produce as many as 13 Porter gunboats. Seven were destroyed; construction ceased on three; but *Chattahoochee*, *Macon*, and *Pee Dee* were commissioned.

History of Shipbuilding and the Civil War around Washington, North Carolina

Still's article, "The Shipbuilding Industry in Washington, North Carolina," is the most detailed secondary study of Confederate shipbuilding in the vicinity of Washington, North Carolina.

The Confederate navy contracted for three warships to be built in Washington. In October, 1861, . . . Myers & Company agreed to construct the hulls of two 130-ft. gunboats for \$16,000 each, and Ritch & Farrow agreed to build one for \$13,200. Only one of the Myers gunboats was actually laid down along with the [Ritch & Farrow] vessel, and neither was completed. On March 21, 1862, Union naval forces occupied the town. The gunboat on the stocks at Farrow's shipyard was destroyed. . . . Myers's gunboat which had already been launched was . . . towed upstream and burned by Confederates (Still 1981:37-38).

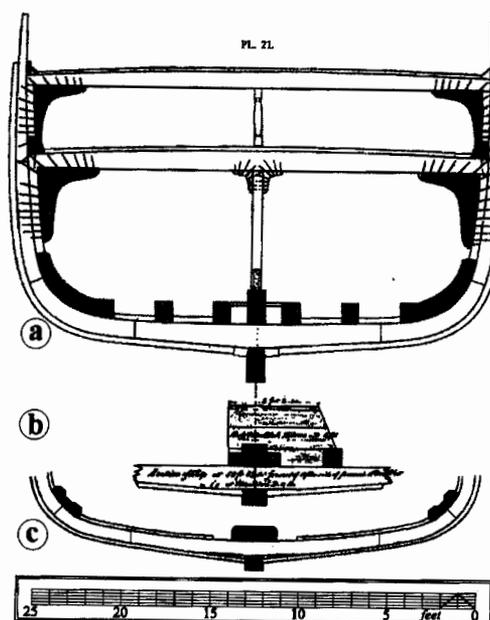


FIGURE 1. Cross-sections of keelsons and bilge stringers: a, typical marine arrangement of keelsons and bilge stringers about 1850 (Griffiths 1854:Plate 21); b, engineering cross-section USS *Seminole* (National Archives, Cartographic Branch 1858); c, cross-section amidships of *Chicod* showing side keelsons and bilge stringers.

Still based much of his discussion on the vessels' contracts. The contracts are unusual because they contain no description of the hulls or machinery (Kean 1863:439-440). To date, researchers have found no historical source that specifically describes any of the warships built at Washington. Still's note that the Myers hulls were 130 ft. long is a problem because *Chicod* is 150 ft. long. When asked about this description, Dr. Still reported that at the time, given the limited information available concerning Confederate gunboats, 130 ft. seemed appropriate (William N. Still 1996, pers. comm.).

What type of vessel was the Myers hull? After Gilbert Elliott (later builder of the CSS *Albemarle*) signed a contract to produce a 130-ft. gunboat at Elizabeth City, North Carolina, the Navy Department turned to Porter to provide Elliott with plans for the vessel. In correspondence directed to Chief Engineer Williamson, dated 26 November 1861, Porter states:

I send you a draft of the Washington gun boats for Mr. Elliot. Let him use the same specifications. He will have to increase his length to suite or he can make her the same length by cutting 20 ft. out of the middle . . . which will make her 130 ft. long, 25 [ft.] beam and 10 ft. depth (Porter in Elliott 1994:40–41).

This statement indicates that at least some of the Washington gunboats were 150-ft. *Macon*-class Porters. According to Commander S. C. Rowan's report of 27 March 1862,

two gunboats [were] on the stocks; one [Myers' hull] . . . was launched and carried up the river out of sight, and was burned the night our forces arrived. . . . The other gunboat [Farrow's hull], of less size, remained on the stocks and was sawed in pieces by our people (Rowan 1862:151).

Rowan's note that Farrow's hull was smaller than Myers's explains why Farrow's contract was \$2,800 less, even though Ritch and Farrow signed their contract a week after Myers. The contract dates are consistent with the Porter gunboat program. Porter states that at least some vessels under construction at Washington were of the *Macon*-class. If Farrow's hull was smaller than the Myers hull, it follows that the Myers hull was a 150-ft. *Macon*-class Porter gunboat.

According to the contract, 1 March 1862 was the delivery date for the first Myers hull without machinery (Kean 1863:439–440). Still (1981:37) noted two payments on the Myers contract. Researchers recently located the third payment on the Myers contract (National Archives 1862). This payment corresponds to Chicod's level of completion. To date, the third payment is the first and only document that possibly links Chicod to Myers and Company. Associated with the wreck is a very credible oral history. The tradition states that the wreck is a Confederate gunboat built at Washington and poled up Chicod Creek (Forest and Babits 1996:18).

Recent discovery of the upper cutwater enables reconstruction of the vessel's bow. The reconstruction bears a strong resemblance to an Aberdeen clipper bow made popular in the 1850s by John W. Griffiths. On 4 November 1861, the date of the last known Porter gunboat contract,

Porter penned a letter in which he mentions a design for his clipper gunboats.

I have two large gunboats [*Hampton*-class] on the stocks here now and expect to put up two more soon [*Hampton*-class]. . . . I have sent plans to Florida, Savannah, Charleston, Memphis, New Orleans, and North Carolina, where they are building gunboats. I received orders yesterday for two more clipper gun boats (Porter in Flanders 1988:45).

Archaeology

Considering the historical research, if the vessel in Chicod Creek is the Myers hull, researchers should find a partially completed 150-ft. *Macon*-class hull with no machinery and exhibiting signs of being heavily burned. There are a variety of historical and archaeological resources that researchers marshaled to test this premise. Archaeological data for the following comparisons is the product of ongoing research by the Program in Maritime History and Nautical Archaeology at East Carolina University.

CSS Macon Deck Plan

The only known construction diagram of a Porter gunboat is the deck plan of the *CSS Macon* (Willink [1861]). This deck plan bears a strong resemblance to Chicod. Based on the intact forward hatch at midship, a second, disarticulated hatch beam, and the hanging knee pattern, reconstruction of the deck shows similarly sized and situated hatches corresponding to *Macon's* deck plan. The vessel's contour closely follows the deck plan. Both exhibit the characteristic round stern of a 19th-century American warship.

Jacksonville Specifications vs. Chicod Creek Vessel

On 3 October 1861, George Mooney completed negotiations with the Navy Department to build two *Macon*-class Porter gunboats in Jacksonville, Florida (Mooney 1861). Table 1 contains an abbreviated comparison between the Jacksonville *Macon*-class specifications and

TABLE 1
150-FT. MACON-CLASS SPECIFICATIONS VS. THE CHICOD CREEK VESSEL

Specifications	Macon-class	Chicod	Specifications	Macon-class	Chicod
<i>Overall</i>			<i>Limbers</i>		
Length	150 ft.	151 ft.	Located over	Garboard strake	First strake
Beam	25 ft.	25 ft. 4 in.	Fitted with boards	Yes	Yes
Depth of hold	10 ft.	9 ft. 11 in.	<i>Stancheons</i>		
<i>Keel</i>			Spacing	Every other frame	Every other frame
Sided	12 in.	12 in.	Wood	Oak	Oak
Molded	10 in.	10 in.	<i>Beams</i>		
Floors joggled into keel	1 in.	1 in.	Sided	10 in.	10 in.
Depth below planking	6 in.	6 in.	Molded	7 in.	7 in.
Wood	White oak	Oak	Spring	3 in.	3 in. (estimated)
<i>Keelson</i>			Distance between beams	5 ft.	Variable
Sided	10 in.	12 in.	Ledges between beams	2	1, 2, and 4
Molded	12 in.	10 in.	<i>Clamps</i>		
Wood	Yellow pine	Pine	Wood	Pine	Pine
<i>Stem and Stern Post</i>			<i>Knees</i>		
Sided	10 in.	10 in.	Sided	5 in.	5 in.
Keel tapered to bow and stern	Yes	Yes	Located under each beam	Yes	Yes
<i>Apron</i>			<i>Bottom Planking</i>		
Sided	10 in.	10 in.	2 spikes, 2 treenails per	Yes	Typically
<i>Stem and Stern Knee</i>			Thickness	3 in. (oak); 4 in. (pine)	2-3 in. (pine)
Wood	White oak	Oak	Scarf	Butt	Butt
<i>Frames</i>			<i>Ceiling Planking</i>		
Paired to sill line	Yes	Yes	Thickness	1.5 in.	1.5 in.
Center to center	2 ft.	2 ft.	Fastened	Spiked on	Spiked on
Floors to side	8 in.	8 in.	Wood	Yellow pine	Pine
Gap between frame pairs	8 in.	8 in.	<i>Gun Deck Planking</i>		
<i>Futtocks and Top Timbers</i>			Thickness	3 in.	3 in.
Sided	8 in.	8 in.	Fastened	Spiked on	Spiked on
Wood	Heart yellow pine	Pine	Wood	Yellow pine	Pine
<i>"Crooked Futtocks"</i>			Plugged over the heads	Yes	Yes
Sided	8 in.	8 in.	<i>Bends</i>		
Wood	White oak	Oak	Thickness	5 in.	5 in.
<i>Floors</i>			Wood	Yellow pine or oak	Pine
Sided	8 in.	8 in.	<i>Water Ways</i>		
Wood	White oak	Pine	Wood	Yellow pine	Pine

Chicod's observed dimensions. Considering the number of comparison points, Table 1 demonstrates that Chicod corresponds to the Jacksonville specifications. With respect to Chicod, specifications alone do not tell the whole story.

The specifications call for a vessel 150 ft. in length. This measurement is the length between perpendiculars for a vessel with a traditional vertical bow. Researchers determined Chicod's length as 151 ft. (Babits 1981:5). Chicod has an Aberdeen clipper bow, and the traditional length

measurement does not apply. If one chooses the center of the scarf of the cutwater assembly, as some clipper designers did, the length is 150 ft., based on the site plan (Forest and Babits 1996:62).

A possible dimensional discrepancy is the 10-ft. depth of the hold. Steffy (1994:254) uses "the depth at amidships from the bottom of the upper deck beam to the top of the limber board." A recovered disarticulated pillar measuring 9 ft. 1 in. establishes the depth of hold at an un-

known point, according to Steffy's definition, as 9 ft. 11 in. Unfortunately, the Jacksonville specifications describe depth as "the lower edge of the rabbet on the keel to the top of the deck beam at the side of the vessel" (Mooney 1861). Steffy (1994:254) cites this depth measurement indirectly as molded depth. For Chicod, Steffy's molded depth equals 11 ft. 5 in.

The specifications provide dimensional information concerning bow components but not the style of the bow. Porter's reference to his clipper gunboats may explain the bow configuration. Griffiths (1854:101–102) asserts that the 50° rake of the clipper bow tended to hog vessels. The current thinking is that some *Macon*-class vessels had the clipper bow and that Porter used flush-mounted side keelsons in conjunction with the bilge stringers to longitudinally strengthen these vessels and prevent hogging.

Bilge stringers and side keelsons are common in American marine and naval architecture in the 19th century (Figure 1a). It is uncertain whether the term *bends* in the specifications refers to bilge stringers, but Chicod's bilge stringers conform to the specifications for bends. Griffiths (1854:217–219) writes at length about bends or bilge stringers. In 1996, researchers mapped Chicod's bilge stringers which run from the turn of the bilge upward and intersect with the aftmost hanging knee and deck shelf.

Neither set of specifications mentions side keelsons. They are not present in the sections of *Chattahoochee* surveyed to date (Watts et al. 1990:35, Figure 17). They are present on Chicod and fastened directly to the outboard flanks of the keelson (Figure 1c). Porter used this uncommon arrangement on the USS *Seminole* (Figure 1b).

CSS Chattahoochee vs. Chicod Creek Vessel

The *Macon*-class was the genesis of the Porter gunboat program. Porter adapted the *Macon*-class design to meet Confederate strategic needs. The *Chattahoochee* was one such adaptation. Comparison of the two sets of class specifications shows that Porter reduced the size of the

Chattahoochee's components along with its overall dimensions. Except for the keel and keelson, *Chattahoochee*-class components side an inch less than *Macon*-class components (Elliott 1994:32–34). Chicod corresponds to the Jacksonville specifications as closely as the *Chattahoochee* corresponds to its specifications. Both vessels deviate from their respective specifications by having pine floors when their specifications call for oak floors.

Chicod and the *Chattahoochee* are similar yet different. The *Chattahoochee* underwent two rebuilds as a result of structural damage. Both vessels have lightly built sterns heavily strengthened by longitudinal timbers with no deadwood. The stern exteriors are almost identical with three gudgeons and a skeg. On the interior, the *Chattahoochee* has a stern knee while Chicod has a wishbone-shaped transom piece. Shipwrights installed the *Chattahoochee*'s stern knee when they replaced the keelson (Turner 1988:86). The compound center transom piece and stringer differ only in their vertical placement. The minor differences in the two vessels reinforce the premise that these were members of different classes of the same construction program.

Conclusion

The archaeological and historical evidence presented above indicate that the Chicod Creek vessel escaped from Washington as an incomplete Confederate gunboat hull with no machinery. It was the first vessel under contract with Myers and Company—a 150-ft. *Macon*-class Porter gunboat. Chicod's recorded measurements and construction features compare favorably to contract specifications for the construction of *Macon*-class Porter gunboats, to the deck plan of the *Macon*, and to observed features of *Chattahoochee*, a smaller class Porter gunboat. Although there are discrepancies, these are minor construction variations explainable in the context of available historical resources. Considering this argument, it is reasonable to assert that the

Chicod Creek vessel is a 150-ft. *Macon*-class Porter gunboat, one of the clipper gunboats of the Confederacy.

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