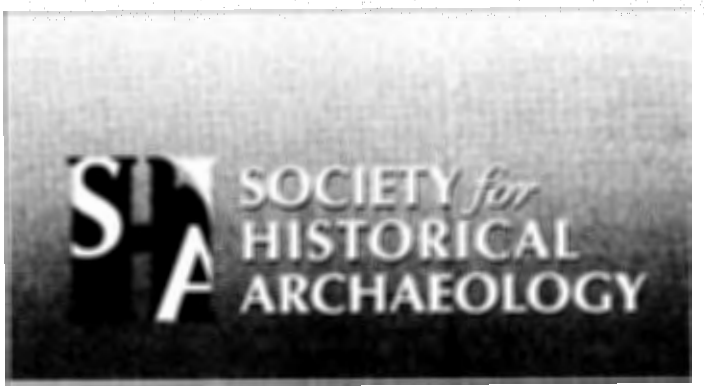

Underwater Archaeology

ADRIANE ASKINS NEIDINGER
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THE SOCIETY FOR HISTORICAL ARCHAEOLOGY AND
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FOREWORD

ADRIANE ASKINS NEIDINGER AND
MATTHEW A. RUSSELL, EDITORS

This year's 32nd Annual Conference on Historical and Underwater Archaeology in Salt Lake City was the 30th meeting to include underwater archaeology sessions in its program. Of 276 papers presented in Salt Lake City, 54 (20%) dealt with maritime-related issues. As the theme for the 1999 meeting, the idea of "Crossroads of the West" was reflected in many of the papers presented. The scope of research and ideas presented suggests that maritime archaeology has reached its own "western crossroads" of sorts, and is positioned to finally shed its long-held image as a "nascent discipline" as it moves into the new millennium. New ideas, research, concepts, and technology reveal the field's increasing interest and acceptance by cultural resource managers, academicians, and the public.

In addition to the many papers presented with a single-site focus, there were some refreshing discussions taking a more anthropological perspective, such as exploring the concept of maritime landscapes and effect of historical salvage on the archaeological record. The involvement and importance of volunteer and avocational archaeology organizations to submerged cultural resources management was strongly evident at this year's conference. Nearly 20% of the maritime-related papers were presented by volunteer or avocational groups or discussed their involvement with on-going projects, signaling the success of public outreach programs and involvement of communities in local maritime cultural heritage preservation.

A review of conference topics and presenters once again show varied areas and periods of research. While much research remains focused within the continental United States, the conference had presenters and topics spanning the globe. International contributions included presentations about research taking place in the United Kingdom, the Caribbean, Canada, and the Pacific.

The importance of graduate programs in underwater archaeology was evident in nearly every symposium. Representatives from the various programs suggested a change in focus—one in tune with the conference theme—to the west. The Hawaiian symposium emphasized the bourgeoning interest in maritime cultures and traditions of the Pacific, as well as the importance of contributions from the University of Hawaii graduate program. California's Sonoma State University cultural resources management graduate program turned to the rich maritime-related material culture of California. Its research delved into not only the concept of maritime landscapes but the important role ethnic minority groups have played in California's maritime heritage. Representatives of other graduate programs present included Florida State University, Texas A&M, and East Carolina University.

A topic of much discussion in Salt Lake City was UNESCO's Draft Convention on the Protection of Underwater Cultural Heritage. A preconference symposium organized by the National Park Service provided a forum for discussing this important agreement. At a time when treasure hunters are consolidating their ranks and increasingly trying to blur the lines between commercial salvage and archaeology, better formal protection of our underwater cultural heritage is necessary. It is vital that archaeologists, both maritime and terrestrial, present a united front against commercial salvage interests. As we get ready to move into the new millennium, it is unacceptable for professional archaeologists to support a compromise position of collaboration with anitiquity harvesters who would salvage and market our cultural patrimony. The argument that "some data are better than no data" is unjustifiable and ultimately serves only to further degrade our unrenewable resource base. Both the SHA Board and the Advisory Council on Underwater Archaeology took an important step in building this united front by passing motions in Salt Lake City in support of UNESCO's Draft Convention.

Underwater Archaeology, 1999:1–2.

We would like to acknowledge Michael R. Polk, Donald D. Southworth, Wendy Simmons Johnson, Shane Baker, Charmaine Thompson, and the rest of 1999's conference committee. Their efforts resulted in a highly successful conference, and their hard work made our jobs as underwater program co-chairs much easier.

Thanks go out to the authors and presenters who made this year's conference a success. This volume is a reflection of their efforts and work. We are also indebted to Dr. Ronald Michael and, especially, Denise C. Lakey, for guiding us through the editorial maze necessary to bring this volume to publication. Michael Rodeffer and Teresita Majewski were also particularly helpful in helping us manage the business end of our editorial duties.

This volume was published with generous financial assistance of individuals and organizations listed on an earlier page. With their help, we are able to usher *Underwater Archaeology* out of the present millennium and into the next. Final thanks go to Daniel J. Lenihan and Larry E. Murphy of the National Park Service's Submerged Cultural Resources Unit for supporting our efforts to organize the conference's underwater program and edit this year's proceedings volume.

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Historical Salvage and Maritime Archaeology

In the preface to the *Encyclopedia of Underwater and Maritime Archaeology*, editor James Delgado reminds us that the ocean is the last great archaeological frontier, and even a cursory examination of this work shows the great strides maritime archaeologists have made over the last four decades (Delgado 1997:6). The depth and richness of research during this time is exemplified by numerous excavations discussed in Delgado's book (Delgado 1997). These four decades have also seen large scale programmatic surveys of submerged cultural resources in places like the Dry Tortugas (Murphy 1993) and Cape Fear, North Carolina (Jackson 1995; Overton 1995). In addition, there is a growing interest in the rich and long-standing Asian seafaring traditions (Van Tilburg 1994; Kenderdine 1995; Muir 1999). Given these great achievements the question emerges, where do we go next? This work introduces a new area of focus for maritime archaeology as we proceed into the new millennium. This new focus centers on the archaeological significance not only of shipwrecks, but also of the salvage of shipwrecks by different and distinct peoples throughout history.

To begin this discussion it is important first to consider some of the elements of the preceding areas of study. Most published works treat shipwrecks as static manifestations of the culture or cultures that produced and used both the ships and the cargoes. Archaeologists have sought meaning from these sites solely in terms of what questions they can ask and answer about the time before, or the time of, the wrecking event.

Generally, these questions are of two types. First, there are those questions that relate to the history of a particular vessel. Simplified forms of these questions are: What ship is this? Who built it? When was it built? Where was it built? How was it built? Where was it going? Why did it sink? What was it carrying? Where was its last port of call? The literature is replete with examples of this type of inquiry (Watts and Krivor 1995; Cozzi 1998). The second set of questions concerns the behavioral aspects of ships' crews, owners and builders. Typically these questions place the operating life of the ship and the shipwreck itself within a broader cultural context. Questions informed by this type of analysis might be: What were the dynamics of seafaring life during the 17th century, the 18th century, or the 19th century? What behavioral factors may account for concentrations of shipwrecks in certain areas? And, more specifically, how does ship construction, fitting out, cargo selection, and maintenance reflect culturally-shaped attitudes toward technology and trade? Here, too, there are many examples of this type of inquiry (Murphy 1993; Conlin 1994; Gould 1995; Souza 1996, 1998). Though the two sets of questions reflect distinctly different views, they are not mutually exclusive. The first set derives from a purely historical viewpoint, and the other set from an anthropological perspective, and both are united by their treatment of the shipwreck event as the last point in time about which questions can be asked. And while questions asked from both perspectives have been the core of meaningful maritime archaeological research, other important questions can be asked. Consideration of historical salvage raises new sets of questions which build upon traditional research and increase the explanatory value of maritime archaeology.

Historical salvage is defined here as the search for and recovery of: the cargo, including passengers; rigging; hull; or any other part of a vessel that has wrecked, stranded, burned, foundered, or is imperiled. Commonly, historical salvage was carried out during or immediately following the shipwreck event, or within the short period after the event, and before the natural degradation processes affected the integrity of salvageable material and rendered the material unsuitable for reuse. Therefore, depending on the cargo or the type of vessel, historical salvage may have oc-

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curred even months or years after the wrecking event.

Recalling Muckelroy's diagram of the evolution of a shipwreck (Figure 1), three important cultural and natural factors are shown to effect the observed sea-bed distribution of the wrecked ship and its cargo: the process of wrecking, salvage operations, and the natural marine environment. Since Muckelroy developed his diagram, the need to account for these factors in the overall interpretation of archaeological sites and shipwrecks has become widely accepted (Murphy 1990; Schiffer 1996). The more recent application by many maritime archaeologists of the concept of site-formation principles to shipwreck sites also distinguish between cultural and natural factors affecting those shipwreck sites (Murphy 1993; Conlin 1994; Coroneos and McKinnon 1997; Souza 1998). Subsequently, salvage itself has been recognized as playing an important role in shaping the distribution and composition of the artifact assemblages of shipwrecks, and published works commonly discuss the likelihood or extent of salvage when beginning to assess the significance of shipwrecks (Coroneos 1996; Kenchington and Whitelock 1996; Souter 1997). However, their discussions of salvage are typically limited to no more than an accounting for the disturbance or loss of artifacts from a site and how this process bears on traditional research questions. Specific questions about salvage relevant to traditional research are: What is missing? What is present? Is the position of this artifact or cluster a product of pre-depositional choices, the wrecking process itself, or the product of salvors grouping salvageable items for recovery at a later time? Are these timbers from the ship or are they left over from a salvage operation? The questions are many, but salvage itself never really becomes the subject or focal point of traditional maritime archaeological research.

Maritime archaeologists usually focus on events that occurred within the confines of a specific temporal context defined by the date of ship construction, or the time of sailing, and the shipwreck event—the *terminus a quo* and the *terminus ad quem*. Notable exceptions occur when comparisons are made between ships that sailed and wrecked in the same area during overlapping or completely separate periods of time, but these comparisons are based on the notion that shipwrecks may be time capsules, sealed by the wreck events (Bass and Van Doorninck 1982:2-5; Lenihan 1983:57-58). Questions about the salvage of shipwrecks are grounded within the specific temporal contexts defined by the wreck events. However, when you take a closer look at salvage, the temporal context for research questions can be expanded, and what unfolds is a rich historical context that, for the most part, has been overlooked by maritime archaeologists.

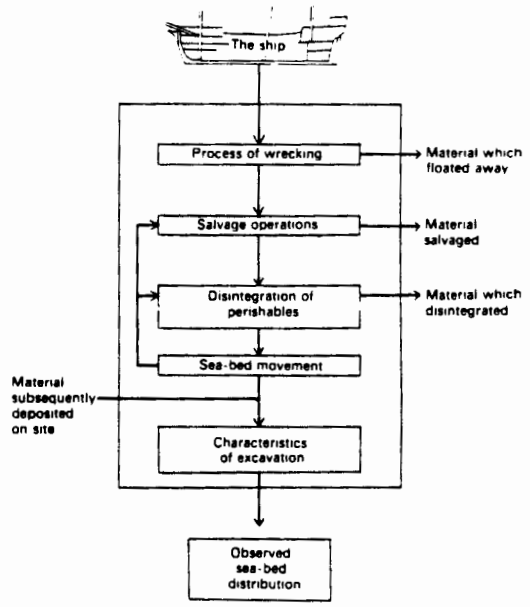

FIGURE 1. Muckelroy's flow diagram representing the evolution of a shipwreck (1978:158). Reprinted with the permission of Cambridge University Press.

In two recent papers, Mark Staniforth laid the foundation for talking about historical salvage. The first paper traces the trajectories of Chinese export porcelain from the place it was produced, through its transportation and deposition, to its final recovery through archaeological excavation

(Staniforth 1996). He suggests that people in the past assigned different meanings to artifacts at various points along their lines of trajectory, and archaeologists may be able to discern these different meanings. The implication of this suggestion is that salvaged objects have extended trajectories and have probably been assigned additional sets of meanings by people or communities in the past. Tracing this use and reuse of artifacts through salvage is central to the study of historical salvage.

In the second paper, Staniforth focuses on the shipwreck event using an Annales School approach. He states: "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" (Staniforth 1997:18-19). Further along he says: "It is at the level of the archaeology of the event and through incorporating the event into the longer term and the large scale (*conjectures, mentalités* and the *longue durée*) that maritime archaeology has some of its most explanatory value" (Staniforth 1997:18-19). The importance of the application of an Annales School approach to historical salvage and maritime archaeology is that it helps to establish an expanded research context within which the extended trajectories of salvaged artifacts and their variable meanings can be addressed. In this way, the *terminus ad quem* of the traditional temporal context within which

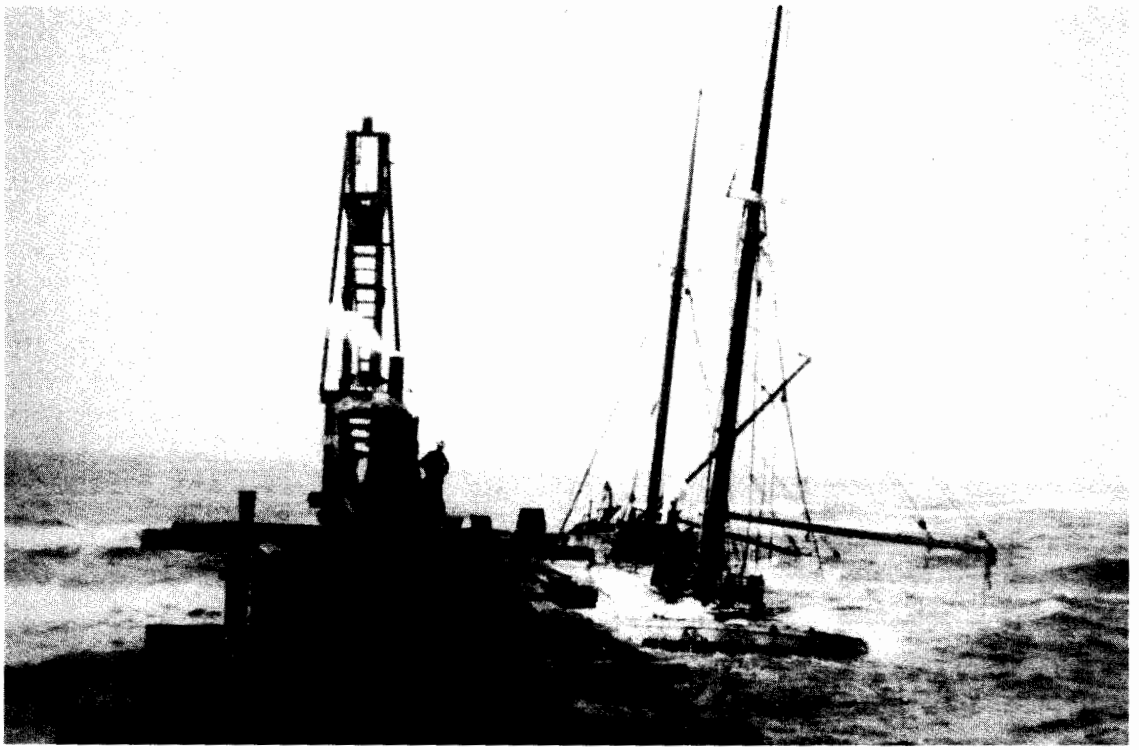

FIGURE 2. View from salvage trestle of the steamship *Corona* stranded on the Humboldt Bar, 1906. (Courtesy of San Francisco Maritime National Historical Park, Joe Muir Collection. E3.8,035.)

shipwrecks are placed and studied is no longer defined by the shipwreck event. In fact, the *terminus ad quem* becomes more difficult to define as objects from shipwrecks are salvaged and reintroduced elsewhere into society after the shipwreck event.

Examples of historical salvage are found in many parts of the world, from Bermuda, the Bahamas, and the Florida Keys, to Australia, and even the northern California coast. Specific examples from the northern California coast serve to highlight the need to redefine the temporal context of the shipwreck event. These examples are of two basic types: those that suggest contemporaneous salvage was, in itself, an important maritime activity which left a distinctive mark on the shipwreck site; and those which suggest continuity between the shipwreck sites and neighboring communities. The examples used here are drawn primarily from a two-year study which explored the potential significance of shipwrecks along the coastlines of the Humboldt and Del Norte counties of California (Simpson 1999). This study relied solely on historical sources and data from newspaper articles, photographs, insurance registries, and official wreck reports. In this manner, 164 reported shipwreck events were investigated. Supporting documents show that of this number, at least 42 were contemporaneously salvaged, or auctioned for salvage. Other supporting data comes from artifact analyses found in the excavation reports of terrestrial archaeological sites along the Mendocino and Marin county coastlines.

The first group of examples indicate the salvage of shipwrecks for reusable material was a common occurrence, and in some cases was the result of a significant, organized, quasi-industrial maritime occupation, which in turn is likely to have left a recognizable archaeological signature on shipwreck sites. The wrecks of the steam ship *Corona* and the armored cruiser *Milwaukee*, stranded near the entrance to Humboldt Bay in 1907 and 1917 respectively, were extensively salvaged following the initial shipwreck events. Each shipwreck was approached and salvaged from a staging constructed out to the ships from shore (Figures 2 and 3). From the salvage trestles, boilers and other steam machinery were removed for later use (Malavos 1972; Hillman 1994). The wreck of the steam ship *Bear*, stranded farther south of Humboldt Bay in 1916, presents a similar picture of salvage, even though there is no record of a salvage trestle being constructed out to the wreck. Nonetheless, a road was cleared to reach the remote site and the wreck was also extensively salvaged. Steam machinery was also removed, including the massive boilers that were transported from the site to Eureka, California (Genzoli 1982:7). Considering these examples, some obvious questions emerge, such as: What materials were salvaged and what materials were not? How was the wreck salvaged? Why were certain objects chosen to be recovered over other objects? Is there a staging area associated with the wreck site? Of course, the examples presented here are only of the salvage of steam-powered vessels, but the same questions could also be asked about the wrecks of sailing vessels.

The second set of examples demonstrate how objects recovered both through serendipitous and through organized salvage sometimes take on new meanings as they were reintroduced into society. In the cases of the wrecks of the *Milwaukee* and the *Bear*, the trajectories of specific artifacts can be traced using historical references. For instance, one reference indicates that tanks or boilers from the *Milwaukee* were used in the construction of the No. 8 steam locomotive of the Hammond Lumber Company, whose logging operations were conducted in the forests around Humboldt Bay and adjacent to the wreck site (Genzoli 1976:5). Another reference indicates the rolls of paper salvaged from the *Bear* were purchased by Arthur M. Smith of the Times Publishing Company, publisher of the *Humboldt Times*, and the paper became the initial capital purchase for the Humboldt Paper Company (Strope 1997:28). Another source indicates that large quantities of flour, sugar, and cornmeal were recovered along with a quantity of bedding including heavy bedspreads with the word

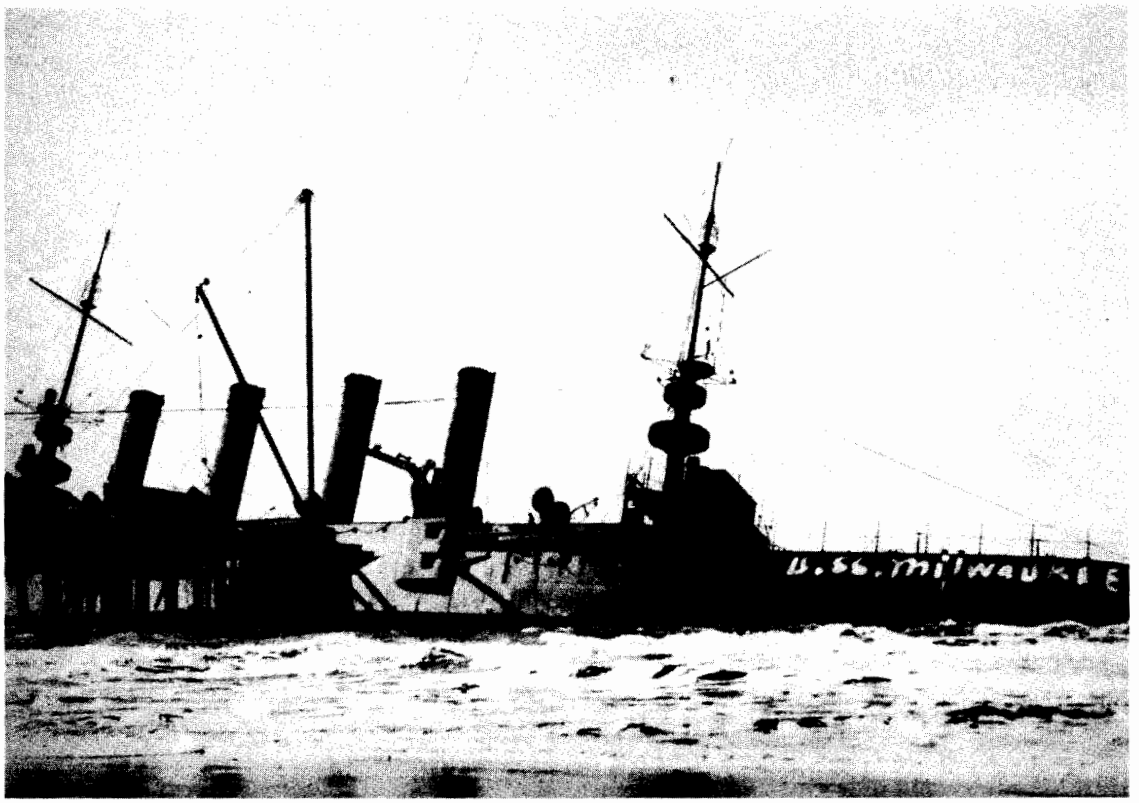

FIGURE 3. View of the stranded armored cruiser U.S.S. *Milwaukee* showing salvage trestle built out to the wreck from Samoa Beach just north of the entrance to Humboldt Bay. (Courtesy of San Francisco Maritime National Historical Park, D. W. Dickie Collection. E3.1,571.)

"Steamer Bear" woven in the centers (Virginia Haley 1997, pers. comm.). The same source also referred to the unusual luxury of having a white cake for a birthday celebration which was made from flour and sugar recovered from the *Bear*.

Farther south, along the Mendocino County coast, the salvage of the wreck of the brig *Frolic* suggests other possible trajectories for artifacts from shipwrecks. In this case, the *Frolic* was salvaged by members of the Mitom band of the Northern Pomo Indians, and historical sources refer to local Pomo women wearing silk shawls (Layton 1997:145). Archaeological excavations at the Three Chop Village site, about ten miles east of the *Frolic* wreck, revealed Chinese ceramic and green bottle glass shards that originated from the *Frolic*. The green bottle glass shards were modified to form projectile point preforms. Analysis of the site indicates that the wreck of the *Frolic* marked the beginning of the historical period for that region (Layton 1990:175). Another example of objects recovered by local Indians may be found in the collections of artifacts recovered during excavations at Drake's Bay at Point Reyes National Seashore. Chinese ceramic shards have appeared in Miwok Indian village sites and have been tentatively linked to either the landing of Francis Drake in 1579 or the wreck of the Manila galleon, *San Augustin,* in 1595 (Shangraw and Von der Porten 1981). In all of these examples, the artifacts have trajectories which extend well beyond the

shipwreck event, either back into Euro-American society or into California Indian society. Here again, many important questions can be asked about the salvage of shipwrecks, starting perhaps with the usual questions concerning what was chosen for salvage and what was not, or who the salvors were. Other interesting and complex questions can also be raised: What economic or social effect did salvaged material have on surrounding communities? Was the impact on the local economy significant? Or in the case of salvaged shipwreck artifacts, which migrate from one culture to another, what different meanings were given to these artifacts of material culture? And, what insights can these differing meanings provide to archaeologists in understanding and explaining cultural changes occurring during and after the contact period?

In conclusion, as issues of culture change resulting from contact are currently being debated for archaeology in general (Cusick 1998), and for the archaeology of the Pacific Rim (Lightfoot 1997), shipwrecks are becoming increasingly more relevant to this debate. And, just as camps and other areas occupied by shipwreck survivors adjacent to shipwrecks have been identified as important contact sites (Nutley 1995), tracing the migration of material culture from shipwrecks, through historical salvage, provides anthropologists, archaeologists, and historians new points of access to moments of culture contact which have significantly contributed to long-term culture change. Additionally, the archaeological implications of historical salvage extend to the management of shipwrecks. As government agencies struggle to determine the significance of shipwrecks, they must now take into consideration the significance of historical salvage as a unique and significant activity. When before, salvage may have been found to have altered the integrity of a shipwreck enough to render it insignificant under a given criteria, the signatures and cultural significance of that very activity can and should now be considered in every step of the evaluation process. And finally, the study of historical salvage affords us the ancillary opportunity to examine the history of the discipline of maritime archaeology and what sets it apart from other types of shipwreck recovery.

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Training Walls and Ferry Slips are not Sexy Lingerie

Introduction

Ordinary landscapes do not usually attract the attention of the average citizen. Common landscape elements seem to have no intrinsic appeal and convey little meaning beyond their function. Ordinary structures at the water's edge, such as piers, quays, wharves, seawalls, jetties, and pilings are not "sexy" like a shipwreck, a statuesque chateau, or Monticello. To most people, these are infrastructure elements, like sidewalks. How could they possibly be historically significant? To some they are "hysterically significant" and will just get in the way of progress. To these people, the historical significance of obsolete old stone training walls that probably never worked in the first place is unfathomable. Evaluating the concrete foundation walls of demolished ferry slips to determine if they might be eligible for the National Register of Historic Places seems ludicrous. The fear that preservation of such ruins will interfere with the construction schedule of important development projects seems overwhelming. But preservation of structures is not necessarily the point. A cultural resources planner at the Port of Oakland helps to identify and evaluate the historical significance of potential historic properties, assess the effects of development projects on those properties and, if necessary, develop a treatment plan to mitigate those effects and preserve the information those properties contain.

The history of Oakland harbor development dates to the mid-19th century. The Port of Oakland, established in 1927, is an autonomous, financially self-supporting department of the City of Oakland, California, created to develop, manage, and promote the City's waterfront. The Port fulfills these responsibilities as trustee for State tidelands and in accordance with the City Charter. As the manager of most of Oakland's waterfront and a major developer of shoreline properties, the Port must comply with local, state, and federal environmental protection laws. These laws oblige the Port to consider the effects of its projects, and those of its tenants, on properties determined to have historical significance.

How do we assess the significance of shoreline resources? Since they are vulnerable and require perpetual maintenance to remain stable under constant tidal action, waterfront structures quickly fall into disrepair and they may deteriorate to the point where public safety is a concern. Alongshore sites and structures are not always attractive and it is most likely that nothing "important" happened there. As a result, historical resources along the waterfront are frequently dealt with as individual elements being affected by separate development projects. They are rarely seen as components of a larger maritime landscape. Disarticulated study, even though it is conducted according to the legal mandate, tends to result in the demolition of these elements without sufficient consideration for the cumulative alteration of the area's historical footprint or the loss of maritime cultural knowledge. One way to comprehend historical significance is to understand the Oakland waterfront as a maritime cultural landscape worthy of scrutiny, the way in which that landscape connects to the greater San Francisco Bay Region, the role of human choice and responsibility in the making of landscapes, and the historical context within which decisions about landscape modification have been made.

What is a Landscape Study?

For the purpose of this paper, the term "cultural landscape" will be used to describe the territory created by human beings—the settings we build for ourselves in relationship to the space that surrounds us—especially those settings that emphasize community and membership (Groth 1997b). Geographer Pierce Lewis (1979) explains that the common usage of the verb "to landscape" generally means to enhance a piece of land with plants in an artful fashion. As the

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term is used in studies such as this, however, ". . . it is proper and important to think of cultural landscape as nearly everything we see when we go outdoors. Such a common workaday landscape has very little to do to with the skilled work of landscape architects, but it has a great deal to say about the United States as a country and Americans as people" (Lewis 1979). Lewis goes on to explain that our human landscape is our unwitting autobiography, though it may not be easy to read. The cultural landscape may be messy and disorganized, but we can learn to interpret it if we use our eyes and think about what we are seeing.

The study of the American cultural environment, or cultural landscape, can be traced to the work of John Brinckerhoff Jackson, who published the first issue of *Landscape* magazine in 1951. Jackson challenged a whole generation of geographers, architects, planners, archaeologists, folklorists and many others to contemplate the interaction between the landscape and the aspirations and needs of the people who inhabit it. Jackson's interest went beyond looking at extraordinary examples of architecture and landscaping to explore the significance of the common, everyday environment (Groth 1997a).

According to Thomas Carter (1998), study of the historical landscape is a type of research that is becoming increasingly prevalent, whether it goes by the name of vernacular architecture, material culture, or cultural landscape studies. Specific topics and methods may vary, he says, but a growing number of people have embraced the idea that the systematic study of the built environment has enormous potential to provide understanding of both past and present human behavior.

This examination of the Oakland shoreline is based on Paul Groth's articulation of the fundamental principles of the study of cultural landscape, which are included in the introductory lecture of his course on the History of the U.S. Cultural Environment at U.C. Berkeley: (1) nearly all items in the human landscape reflect culture in some way; (2) the evolution and continuing existence of most cultural landscapes are intimately related to landforms, climate, soil, and plant life; (3) humans are a part of nature, therefore their habitats are a part of nature; (4) history matters when trying to unravel the mystery of the present landscape; (5) often elements of the cultural landscape make little sense if they are studied out of their local context; (6) landscapes are the true reflection of culture and cultural change; people tend to say things in landscape that they would never say in words (Groth 1997b). Groth emphasizes that *ordinary* is a key word in landscape study and that ordinary landscapes are important and worthy of study. What frequently attracts interest is a particularly beautiful example of architectural style (e.g. Italianate, Queen Anne, or Craftsman), a designed landscape (e.g. Golden Gate Park), or buildings associated with prominent people (e.g. Mount Vernon). Observation and analysis of the everyday built environment, however, can reveal profound changes in cultural activities found in an area over time (Carter 1998).

Context

During the last half of the 19th century, the San Francisco Bay Area was developed from a sparsely settled agrarian region into a thriving metropolis. According to geographer James Vance (1964), the initial American period in the Bay Area was characterized by an open-extensive settlement pattern due to the presence of a body of water which permitted the near-instantaneous creation of a regional transportation system. That water-based transportation system extended far into California via the river system. Transportation of passengers and cargo by water was a commonplace event throughout the Bay Area and the general public encountered shoreline structures on a regular basis. This is no longer the case. Since the turn of the century, Bay Area residents have increasingly relied on the automobile for transportation, as has most of the population of the United States. Bridges throughout the Bay region carry daily commuter traffic high

above the water and there is little on the landscape of today's superhighway to indicate when one actually leaves the land and ventures out over water. With the advent of regular air travel, the number of ocean-liner passengers has drastically declined. The shoreline landscape has become increasingly alien to the average citizen to the point where only working mariners and small boaters develop any familiarity with it (Stilgoe 1994).

Most of the Oakland waterfront, occupied by Port of Oakland Marine Terminals, Southern Pacific and Union Pacific Railroad Yards, the now-closed Fleet and Industrial Supply Center, and a variety of industrial properties, has become a specialized landscape, shaped by the increasingly specialized spatial requirements of industry and transportation technology of the past and present. A 19th-century resident of Oakland would find nothing familiar about today's landscape and would not even recognize the landforms. Since 1882, hundreds of acres of tidal marsh lands on both sides of the Oakland Estuary have been filled, dramatically altering local geography.

Case Study 1: Oakland Inner Harbor Training Walls

The shipping channel and the training walls that helped to define the basic footprint of waterfront development in Oakland are over 100 years old. They were constructed by the U.S. Ar.ny Corps of Engineers between 1874 and 1896, as part of a federal harbor improvement program, and once extended into open bay waters for almost two miles with no land on either side. As an alternative to dredging in the 19th and early-20th centuries, engineers attempted to harness the power of nature with training walls, two parallel stone or concrete walls, which were built to enhance the natural currents to scour and deepen the shipping channel of a river or estuary.

Jetties, breakwaters, or wave protection structures are usually covered with a layer of loosely-placed large stone, commonly referred to as riprap, with many faces and voids to dissipate wave energy. This kind of shoreline treatment is common: piles of rocks, great granite blocks, and even concrete rubble from a demolished building strewn along the shoreline. The Oakland Inner Harbor training walls are different. They are faced with large stones, hand-set in a dry-masonry technique, which gives them an unusual, smooth appearance.

Before the training walls were constructed, the Oakland estuary was a shallow, silted slough that could only be navigated by boats with a draft of 5 or 6 ft. Ocean-going ships simply could not make it over the bar, even at high water. The training walls were a grand experiment that never really succeeded as a self-flushing operation, and the federal channel between them has always required routine dredging. Nevertheless, the walls were crucial to the harbor improvement program in Oakland and are the oldest surviving remnant of that program. All other improvements, including extensive filling projects, have grown up in reference to the established channel, as delineated by the training walls. The training walls, with their dry-masonry facing, represent an important engineering feat in their own right and, combined with other harbor improvements, contributed significantly to the economic growth and population expansion of Oakland and other East Bay cities and have continued to do so since the last decades of the 19th century (McCarthy and Lerner 1997).

Efforts to evaluate the training walls in anticipation of base transfer and reuse planning of both the Fleet and Industrial Supply Center and the Alameda Naval Air Station illustrate the utility of applying a maritime landscape perspective to shoreline resources. In 1996, when this project began, Richard Lerner, anthropologist at the Army Corps of Engineers, San Francisco District, had been conducting research and was interested in looking at the resources (both north and south walls and the channel) as a system. The Navy conducted its own evaluation of a portion of the south wall. The Port of Oakland's

initial survey of the north wall recorded only a fraction of the resource. These site-oriented studies identified only a portion of the resource, largely because survey was conducted from the land only; no view was taken from the water. At Lerner's suggestion, a survey from the channel waters was conducted in July 1997, which clearly showed that although a considerable portion of both walls has been covered with fill or destroyed, significant portions of both the north and south training walls remain. They are visible at most tidal levels and their overall integrity is high. Some sections of the walls have deteriorated and other small areas have been repaired but the large sections of the jetties that are still visible retain a significant portion of their integrity of design, material, workmanship, feeling, and association and are able to convey these qualities, especially when viewed from the water or from the opposite shore of the channel. The State Historic Preservation Officer concurred with the determination that the training walls and federal channel are eligible for the National Register.

Case Study 2: Western Pacific Mole

A second case study involves an assessment of the remains of two ferry slips on the Western Pacific Railroad's Oakland mole, located on the shores of San Francisco Bay at the north side of the western end of the entrance to the Oakland estuary. A mole is a large structure of earth or stone that extends out in the water and has a large, flat surface which can be used for the transfer of cargo and passengers between boats and land-based transportation. The two ferry slips at the Western Pacific mole—one for freight, the other for passengers—were placed into service in 1910. Passenger operations between Oakland and San Francisco continued until mid-1933, when passenger service was terminated at this location and transferred to the Southern Pacific Railroad's mole just to the north. The passenger terminal and train shed were demolished in 1940 but both slips continued to operate as a transfer point for freight until 1978. An evaluation of the entire complex was made in 1985 and the resource was determined not eligible for the National Register because alteration and demolition had severely impacted its historic character (Wall and Delgado 1985). Shortly after this evaluation, the wooden fender and decking system was demolished. An evaluation of the remnants of the mole foundations in the summer of 1997 reaffirmed the near total loss of integrity of design, materials, workmanship, feeling, and association (McCarthy, Corbett, and Minor 1997). This site, however, is of local importance for two reasons. First, the establishment of the Western Pacific mole at this location set in motion the legal process that enabled the City of Oakland to regain title to a significant portion of its waterfront. Second, the site has evolved into an intermodal transportation facility and thus the setting represents the evolution of transportation technology. While the facility is not eligible for the National Register, one has merely to walk out to the edge of the mole foundations and view the San Francisco skyline in the distance to feel the sense of embarkation that remains. Many sites encountered within the Port's jurisdiction may not possess enough integrity to be eligible for the National Register but they may be of local importance and may meet the standards for recognition under other state and local programs. Sites of local interest that are located in public access areas provide an opportunity for public education. When viewed as part of Oakland's maritime cultural landscape, even concrete retaining walls, the fragments of a once greater facility, can be interpreted and convey the historical significance of the site and the events that occurred there.

Long-Term Management Strategies

What strategies should be used to ensure that shoreline resources are adequately assessed? Essentially, waterfront surveys may require alternative methods of study. Properties located along the shoreline should be viewed from the

water as well as on land whenever possible. Surveys should be undertaken at a low tidal levels, in order to ensure that resources that may be partially or wholly submerged at higher tidal levels may be viewed. In addition, viewing shoreline development as a cultural landscape, allows an evaluator to determine significance from a broader, less particularistic point of view. Seemingly useless elements of the transportation infrastructure, when viewed in relationship to the articulation between the water and the land, take on new meaning. An important component of a long-term cultural landscape approach to maritime resources within the Port's jurisdiction is to develop a property typology. The Port's waterfront resources extend from San Leandro Bay along the Estuary to the Outer Harbor in San Francisco Bay and include a wide variety of property types. Development along the shoreline has largely occurred in relationship to the confluence of transportation modes in the area; therefore, as transportation technology has evolved, so have the related features. Significance can be assessed in relationship to the property type and its associated themes. Historical research and field survey indicate that seven historic-period property types may be present within the Port's jurisdiction. These categories are: transportation infrastructure, shoreline stabilization structures, industrial properties, commercial properties, domestic occupation sites, military properties, and submerged sites.

Another primary objective is to develop research themes and pose questions that will assist in determining the historical significance of these property types. Who built this? What was its purpose? Where did the materials come from? Why does it look the way it does? What does it tell us about the development of structure and infrastructure in the Bay Area? Does it reflect the relationship between public attitudes about the environment and the development of public policy? Does its scale demonstrate the efforts of private enterprise or municipal development? Does it aid in the understanding of the impact of transportation technology on local geography? Does it contain information about people who inhabited the shoreline? What does it tell us about the relationship between human beings and water-based transportation? Does it contain evidence of poorly documented or undocumented processes that could add to the body of maritime cultural knowledge? Does it have interpretive potential? Asking questions such as these about the historical materials in the landscape that have survived into the present can help us to construct the past of a community, approach an understanding of how and why things may be different in the present, and incorporate this understanding into our plans for the future.

At the end of the 19th century, most ships were made of wood and were loaded and unloaded by men with hand trucks. Now, at the end of the 20th century, ships are made of steel and are loaded and unloaded by fewer men operating enormous machines. While many other waterfronts languish in obsolescence, Oakland's is dynamic. Planners at the Port of Oakland are completely re-envisioning the Oakland waterfront to accommodate both deep-draft, ocean-going container vessels and the desire for more open space and public access to the shoreline. The shoreline in Oakland is an evolving maritime cultural landscape. The aim is not necessarily to preserve all the material remains of the past, but to document them and to maintain the body of maritime cultural knowledge so people will be able to remember they were there. Recording maritime cultural resources, evaluating their historical significance, and interpreting them in public access areas has become part of the planning process. Establishing thresholds of significance that relate to the whole and enable us to see the ordinary, rather than restricting our vision to disarticulated sites, can only aid in that effort.

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Inland Waterways of the California Delta: Identifying and Managing a Maritime Landscape

Introduction

"Notoriously swampy and overflowed" would be a more appropriate title for this article. Surveyors used this phrase to describe the wet marshlands that were inaccessible to mapping crews. Their language alone, as viewed on historic maps, implies a cultural value about such lands. Not only were the swampy and overflowed lands inaccessible to surveyors, but they were also considered inaccessible to farmers, land developers and land owners. Notoriously swampy and overflowed meant a wet and boggy, reed-covered land, infested with mosquitoes in the summer, flooded and water-covered in the winter. In other words, a place no reasonable person would want to settle. Yet, the Montezuma Slough region, along the western edge of the California Delta, is just such a swampy and overflowed region and it has a long and varied cultural history. Various groups have valued both the land and water in this region and such cultural perceptions can be viewed in the maritime landscape that exists today.

Current archaeologists and other outsiders view the Montezuma Slough region as an empty or little used agricultural region. Such an approach significantly affects the methodology of local historical surveys where only landscape or ranch features are identified and recorded. An accurate analysis of the Montezuma Slough landscape must include careful observation and recording of both land and water features. Recognizing the diverse features of a maritime landscape requires detailed knowledge of a region and a close understanding of water features. When a maritime specialist is not available, archaeologists need methodologies and vocabulary to recognize and describe a maritime landscape.

Geographical Description

Montezuma Slough lies near the confluence of the Sacramento and San Joaquin rivers, on the north edge of Suisun Bay, approximately halfway between San Francisco and Sacramento. The slough itself actually has two outlets into Suisun Bay, one to the east, near the confluence of the two rivers, and one to the west and farther north along the bay. The direction of flow for Montezuma Slough is influenced by coastal tides and currents, and varies from east to west or west to east. The area of significance is quite linear and encompasses the eastern portion of the slough and the lands along its edge, from the town of Collinsville to the historic site of Mein's Landing. The Montezuma Hills lie to the east and Grizzly Island lies to the west. Several historic landing sites lay along Montezuma Slough, including Dutton's Landing, Bird's Landing, and Mein's Landing.

Historical Background

The development and growth of landings as important points in a vast trade network occurred during the California gold rush. Prior to 1848, the Delta saw moderate use by local Native American tribes, particularly for hunting and fishing (Kroeber 1925; Heizer and Whipple 1971), but little use by Spanish and Mexican settlers. During the gold rush, however, traffic on the Sacramento River increased, carrying miners from San Francisco to Sacramento (Holliday 1981). Settlers started farming and ranching the fertile soils adjacent to the rivers and sloughs, a more reliable and often more profitable venture than gold mining (Dillon 1982). Small, shallow draft vessels were best suited to the narrow channels and these boats made frequent stops at individual farms and small landings. Maritime trade continued after the completion of the transcontinental railroad, often operating in tandem with the rail companies. The real decline in maritime trade began with the introduction of trucks and the building of bridges. Farms and ranches could be

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reached by land at cheaper rates, increasing the growth of truck traffic, while decreasing maritime traffic. Although maritime transportation in the Montezuma Slough region has declined as an industry, a certain maritime orientation can still be seen today.

Visual Description

Historically, almost all aspects of daily life along Montezuma Slough were oriented towards the water, but even today it is hard to ignore the water's dominant presence. A valid description of the Montezuma Slough area could be as simple as flat and wet, and the casual observer might look no further. Yet, there is much more detail if one only takes the time to look more carefully. True, the land here is flat and there does seem to be water everywhere, but look carefully and certain important landmarks stand out. Mt. Diablo is an ever-looming presence to the south, constantly helping to orient oneself when wandering the marshes. The Montezuma Hills provide a backdrop for the eastern boundary of the slough and provide some variety from the surrounding flat, unbroken landscape. Grizzly Island is surprisingly colorful with a wide variety of plants and animals.

Throughout the region, large, exotic, eucalyptus trees are clear indications of human use and modification. Long lines of trees mark field boundaries, provide wind breaks for modern and historic ranches, and often mark historic landing locations. Two large eucalyptus trees at Dutton's Landing can be seen from miles away, providing a useful navigational tool.

Levees wind and twist their way alongside the slough and are less noticeable from the land than they are from the water. Many roads here lie atop the levees, usually providing dry transportation. Standing on top of the higher levees, one can see across the slough to other ranches or into the marsh. From the water, however, the world looks very different. The dirt and vegetation that make up the levees create a distinct border between water and land, almost tunnel-like. One can see ahead (forward) and behind (aft), but views to the left (port) and right (starboard) are blocked. This does not mean there is nothing to see from the water. If careful observers look towards shore, they will notice wooden pilings at regular intervals, on both sides of the shore. Some of these are old, rotting pilings with reeds growing on top; others are newer pilings that support agricultural pump stations. Near the historical landing sites, both new and old, the density of pilings increases. Most of these features are not visible at high tide and are definitely not visible from land. A view from atop the levee gives a broad overview of the region and its patterns, but a view from the water gives more subtle detail.

Of course, the season and local weather patterns can significantly alter the look of the landscape. During the dry summer months, the marshes may be green and colorful, but the surrounding hills and grazing lands are a scorched, dry brown. The fall and winter rains bring bursts of vivid greens, creating a lush, almost tropical look. Dry, solid lands can be quickly transformed into wet and boggy marshes, either by the pooling of water behind levees, or by the actual breaking of a levee wall. The cloudy, rainy skies can obliterate familiar landmarks and features. Throughout the year, the low-lying tule fog can reduce visibility to inches.

Maritime Landscape Typology

A maritime landscape is not represented by a single place, activity, or material remnant. Historically, maritime activities were diverse and encompassed a variety of spaces. For the Montezuma Slough region, four landscape categories help to classify the development and modification of the maritime cultural landscape. Each category has two components: (1) a historical activity, known through primary records, which produced (2) the material remains visible today. The four landscape categories are: the waterway, landings, land features, and modification of the slough.

The Waterway

First, the channel itself linked the farms along Montezuma Slough to Sacramento, San Francisco, and points beyond. For decades in the Delta, the waterways were the only reliable transportation system. Roads were few, rarely crossed the marshes and sloughs, and often flooded or became muddy and impassable. Even the transcontinental railroad avoided the marshes and passed to the west of Suisun Bay. Navigating the narrow channels, understanding tides and currents of the bays, sloughs and rivers, and knowing the location and frequency of landings required a unique knowledge base, probably limited to those working the river. Direct historical reference to such knowledge is rare and few documents discuss the lives of boatmen. Also, vernacular watercraft were designed and built specifically for this region, so boat design often reflects local variations. Shipwrecks and navigational aids are the few material remnants of waterway activity.

Landings

Landings were the meeting points between the maritime and agricultural worlds. A variety of boats traveled along Montezuma Slough, stopping at local landings, bringing a wide variety of goods to local residents: groceries, textiles, mail, even beer and wine. The same or similar boats transported local products: milk, eggs, cattle, grain, to market in Sacramento or San Francisco (Dillon 1982; Walters 1983). Throughout the Delta, landings varied from simple brush pilings, where gang planks were used to transfer goods between ship and shore, to more formal wooden structures or piers. In the 10-mi. stretch of slough between Collinsville and Mein's Landing, historic maps show six landings, three of which have historical documentation (Dakin Publishing Company [DPC] 1885a, 1885b, 1885c). The landings at Dutton's, Bird's and Mein's had wooden wharves that lay parallel to the shore, with large warehouses at the water's edge (DPC 1885a, 1885b, 1885c). Current material culture remains include the pilings that mark these historic locations and the archaeological remains of the landing sites. As mentioned earlier, eucalyptus trees can also mark such sites.

Every piling that exists on the slough today does not represent a former historic site. Often newer pilings are driven near older, established pilings, which reinforces a continuum of use. Also, some pilings could indicate other intermediary links between land and water, like sounding boards or navigational aids, but these uses require more research.

Land Features

Focusing directly on land does not mean one can ignore the water. Boats only traveled up Montezuma Slough because there were goods to be bought and sold. On the other hand, the only reason that any of the ranches were here was because their goods could easily be transported to a profitable market. One could not have existed without the other. Many land features reflected the important relationship between land and water. The front doors of houses faced the water, barn doors opened directly onto the water so that grain and livestock could be easily loaded and unloaded. Cows were marched on to barges and taken directly to market. Collinsville, an Italian fishing village, was built entirely on stilts, raised above tide waters, with a boardwalk for its main road. According to local accounts, children rowed boats from their homes to school. Even today, Collinsville has a row of houses directly facing Suisun Bay and the road sign has been moved from the interior of the levee, between the houses and the road, to the top of the levee, between the houses and the water. Land features like house and barn orientation reflect the value of the river as an important resource.

Modification of Waterways

The fourth and final activity category is the control of the waterways. As the value of agricultural lands grew, so did the need to control

the slough. A delicate balance was necessary to protect local properties from winter floods while maintaining the waterway. Although the recurring floods restored the fertile soils, they also destroyed towns and ranches. Local residents chose to protect their farm lands from such disasters yet continued to recognize the importance of the waterway as a transportation connection to markets throughout California. To control the slough, levees were built to protect the land, while dredging helped to maintain the waterways (Kelley 1989). Dredging is not common on Montezuma Slough, but levees are one of the most visible features on the landscape today.

Conclusion

A historical survey of the Montezuma Slough area that only studies ranch complexes, misses the intricate workings of an integrated maritime and terrestrial landscape. A narrow, land-based study also reflects the values and perceptions of a modern outsider and fails to record the local, historical values. By developing methodologies that examine a complete cultural landscape, archaeologists and historians can better record and analyze local landscapes, both terrestrial and maritime.

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Major Steam-Era Wrecks and Associated Sites of the West Kootenays, British Columbia

Europeans arrived along the coast of British Columbia, Canada's western-most province in the mid-18th century. The Russians came across the Bering Straits from Asia, the Spanish and then the English sailed north along the Pacific coast of North America, while the British trading companies came from the east, through the mountain passes. All were in search of marketable commodities, initially animal pelts then, in the 19th century fish, minerals, coal, and, later still, lumber.

By the mid-19th century, competition among the various foreigners (chiefly the Russians, Americans, Spanish, and British) was largely over, leaving the British in control of the region through the Hudson's Bay Company (Mouat 1995).

In 1846, Britain and the United States agreed that the 49th parallel would form the border between their territories, and the Hudson's Bay Company moved their headquarters from Fort Vancouver, at the mouth of the Columbia River, to Fort Victoria, at the southern tip of Vancouver Island. Three years later, Vancouver Island became a British colony, while the mainland was recognized as the territory of New Caledonia, which belonged to Britain. In 1858 gold was discovered in the Fraser Valley, and the large surplus of prospectors, who were ranging all over the western part of the continent looking for gold following the end of the California gold rush in 1849, streamed into British Columbia. Alarmed by the overwhelming numbers of Americans arriving in the territory, Governor James Douglas of Vancouver Island declared the mainland to be a colony of Britain. In one year, the European/American population jumped from a few thousand to 25,000. Unfortunately for the new immigrants, the placer gold along the Fraser River soon dried up and the miners drifted further north, first to the Caribou, and then east, to the Kootenays in southeastern British Columbia in search of larger deposits of gold.

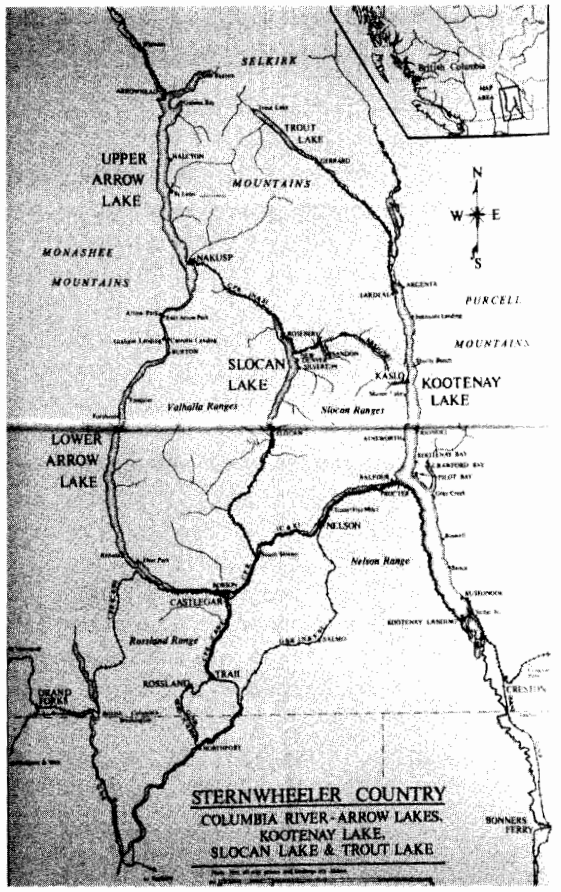

FIGURE 1. Map of Sternwheeler Country. Courtesy (Turner 1984). Reprinted with the permission of Sono Nis Press.

The two British colonies were united in 1866, and in 1871, in exchange for assuming the colony's debt and the construction of a railroad linking the east coast to the west, British Columbia became a province of the new Dominion of Canada. The promised rail link with the east, the Canadian Pacific Railway (CPR), was completed in 1885.

Underwater Archaeology, 1999:21–26.

The existence of hard rock bearing gold in the Kootenays was first recorded in 1844 by Hudson's Bay Company. The report noted, however, it would be impractical to pursue mining in the region, as one would have to transport the rock, by mule, 966 km to the coast. With the completion of the CPR in 1885 and the Northern Pacific Railroad, just to the south of the border in 1883, the prospect of mining in the Kootenay area became feasible. By 1887 there were more than 500 miners in the area and large deposits of gold and silver were discovered in 1889-1890. The American businessmen and miners in Washington and Idaho were well positioned to take advantage of the mining opportunities north of the border, and, in fact, they dominated the industry until the completion of CPR's southern line through the Crow's Nest Pass in 1898. However, before anyone could make a reasonable profit, a transportation network had to be developed to facilitate the movement of equipment, men, and ore from the mines to the railheads and then to market.

The geography of the region is dominated by several high, rugged, mountain ranges running north to south. In the valleys between these ranges are swift flowing rivers and steep-sided lakes, some more than 128.8 km in length (Figure 1). Overland transport east to west by pack train was arduous and impossible during the winter. The natural movement of people and goods in the area was, therefore, north to south. Water-born transport offered an easier and more reliable alternative to packing overland along the shores of the lakes.

Given their experience on the rivers of the eastern United States, it was recognized that sternwheel steamboats were ideally suited for these conditions. In the hands of an experienced crew, these vessels could navigate the shallows and rapids that characterized the principal rivers in the region: the Fraser, Columbia, and Kootenay. The first primitive sternwheeler appeared on the Arrow Lakes-Columbia River route in 1865, but regular, sustained service on this route did not begin until 1888. The 16.4 m *Dispatch* was the first on this route. The first rail-sternwheeler connection from the CPR junction in Revelstoke through to Little Dallas, Washington, via the Columbia River and Arrow Lakes was made in the summer of 1890.

The two companies that stand out in the story of steamship navigation in southeastern British Columbia are the Columbia and Kootenay Steam Navigation Company (C&KSNC) and its eventual successor, the Canadian Pacific Railway's Lake and River Service. The ever-expanding network of sternwheelers, steam tugs, and rail barges provided a means of servicing the area from 1890 through the 1930s when the rail links to the major towns were completed.

The heyday of sternwheelers lasted from 1890 through World War I. Gold rushes, steamboat races, picnic excursions, moonlight cruises, white-water running, fires, and groundings were all part of the sternwheeler tradition (Turner 1984). During this time the steamboats evolved from primitive examples of frontier carpentry to elegant vessels built to the highest standards. Mail, settlers and visitors, supplies, and news of the outside world were all delivered to the isolated mining and logging communities by steamer. Like the railway stations in small western towns, the steamship landing became the focus for many communities (Turner 1984).

The steam-era ships provided an efficient alternative to railroad construction for many years. Many of the ships were lost by grounding, sinking, or to fires; others still were dragged ashore, stripped, and abandoned; while some became floating bunkhouses for miners, or fishing and hunting lodges. One, the *Moyie*, whose career spans the entire history of the CPR's sternwheelers, stayed in service through the 1950s and is now a museum in Kaslo (Figure 2).

In 1991, the Underwater Archaeological Society of British Columbia (UASBC) started a reconnaissance inventory of the more accessible steam-era wreck sites and associated land sites to determine their condition. Between 1991 and 1995 their work identified a wealth of historic material, in total 38 steam-era wrecks, rail-barge

FIGURE 2. Sternwheeler *Kuskanook* with the *Moyie* in the background. (Courtesy of the Provincial Archives of British Columbia.)

sites, and several landings and submerged railyards were located.

Based on these initial results, the UASBC received a grant from the British Columbia Heritage Trust to produce and publish an inventory of historic, freshwater submerged sites in the West Kootenays. The project will include detailed surveys, maps, and archival research on the 17 most significant sites and will provide the UASBC an opportunity to educate the local divers, municipalities, and the general public about their submerged cultural heritage. Additionally, the UASBC will provide advice to the Archaeology Branch of the Provincial Government on how to manage these resources in the future. This funding was matched by the Columbia River Basin Trust in 1998. This additional grant will fund a multi-beam sonar search of the Arrow Lakes in the areas surrounding Arrowhead, Beaton, Galena, and Naksup, and the development of a web site on the project.

There was some urgency in undertaking this project as, despite new legislation protecting shipwreck sites, several of the associated land sites were under threat of development from private individuals and municipalities. In addition, large-scale underwater log salvage activities in various lakes have the potential of damaging several wrecks.

The cold, generally ice-free, waters in these lakes have ensured excellent preservation of wooden and steel-hulled vessels, rail cars, and steam-plant equipment. The wrecks and hulks remaining in these lakes provide a remarkably complete collection from every facet of steam-era navigation. Some of the more important sites

that will be featured in the project will include the following vessels and submerged heritage sites from the three major lakes in the region.

Kootenay Lake

The *Ymir* (Figure 3) was launched in 1898. This 29 m steam tug was the first built for the CPR's barge service on Kootenay Lake. The vessel was retired in the 1920s, scuttled in 1930 and now lies in 17 m of water directly under the Nelson Bridge. The ship is missing its engines and superstructure, but the hull and deck are intact, as is the boiler. It is perhaps the best-preserved example of a steam tug in the area.

The Procter Railway Transfer Barge Wreck, which is a dump of seven rail cars and the 60 m wooden hulled sternwheeler *Kuskanook* (Figure 2) are detailed elsewhere (Pollack and Woodward, this volume).

The *City of Ainsworth* was one of the more infamous vessels on the lake. Built in 1892, the 26 m sternwheeler sank in 1898 with the loss of nine lives. It lies in 110 m near Cape Horn at Crawford Bay. This vessel was located by side scan sonar and inspected by a remotely operated vehicle (ROV) in 1990 by the UASBC and local Dambusters SCUBA Club. In 1998 a deep-diving team from Florida visited the site and completed a photo and video survey of the virtually intact vessel for a Discovery Channel special.

The *Kookanee* was a 44 m sternwheeler that was built in 1896 by the C&KSNC in their Nelson shipyard. The hull was a lake-boat design, drawing 1.8 m, which was deeper and rounder than those ships used on the rivers. The *Kookanee* was the fastest ship of the C&KSNC fleet. The vessel remained in service until 1923 when its steam plant was stripped out and sold and the waterlogged hull was converted into a floating hunting lodge. It sank, but the lower frames and hull are intact in 8 m of water.

The *Hosmer* (Figure 3), a CPR steam tug, and the old Nelson transfer yard and sternwheeler wharf, a large, complex site of 360 submerged pilings and piers, are discussed in detail elsewhere (Pollack and Woodward, this volume). In addition to the transfer facilities in Nelson, there are three other rail-transfer wharves along this lake.

Arrow Lakes

The 1895 the C&KSNC launched the lavish 52 m sternwheeler *Naksup*. This was the first non-utilitarian vessel they had built and at the time, had twice the tonnage of any other vessel on the lake. The *Naksup* was 10.2 m in breadth, 1.9 m deep, and it could carry 15 carloads of freight. In early 1897 the CPR purchased all of C&KSNC's vessels. Later that year the *Naksup* ran aground, burned, and sank at the wharf of Arrowhead on 23 December. A sonar search will be needed to find this vessel.

The *Bonnington*, a 61 m steel-hulled sternwheeler, was the most luxurious lake vessel in the system. Built by the CPR in 1911 to replace their old, smaller wooden vessels, the ship was 12 m in breadth and 2.3 m deep with an almost flat bottom. It drew slightly more than 1 m when fully loaded. Unlike all its predecessors, the CPR added a fourth deck to this vessel for passenger cabins. Its gross tonnage was 1,700 tons, exceeding the next largest CPR vessel by 70 percent. The engines were compound cylinders, which allowed for greater fuel efficiency and were the type used on all the CPR coastal and deep-sea vessels. To complement the luxurious ship, the CPR built a huge hotel at Balfour. Unfortunately, the start of World War I forced the hotel to close, although the vessel stayed in service until 1931. It now rests in shallow water in the Beaton Arm of Upper Arrow Lake. The superstructure of the wreck is missing as are the boilers and engine; however, the entire hull is intact and some of the other machinery present includes: the forward capstan drive, engine and paddle wheel supports, and shaft.

The Arrow Lakes contain numerous vessels including the 38 m sternwheeler *Revelstoke* and the 23 m *Yale*. These vessels will be the focus of the 1999 sonar search.

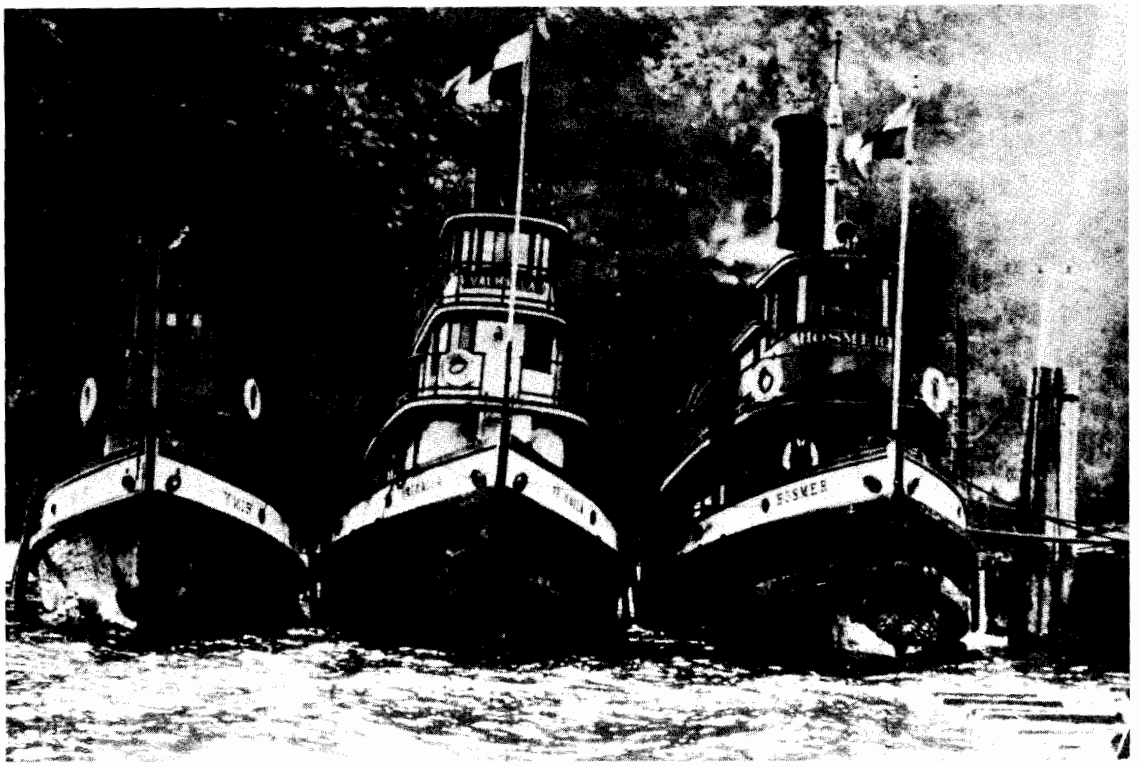

FIGURE 3. Canadian Pacific Railway Steam tugs: *Ymir* on the left and the *Hosmer* on the right. (Courtesy of the Provincial Archives of British Columbia.)

Slocan Lake

One of the most complete examples of a railway transfer barge was abandoned along the shore on the west side of Slocan Lake. Accessible only by boat, the bow of the barge is out of the water but the stern lies at a depth of 27 m.

Conclusion

Over the past two years, with the assistance of local historians and museum societies, the UASBC has completed the archival research portion of the project and has begun detailed mapping of 14 of the 17 sites to be included in the funded study. Plans are underway for further fieldwork to detail the now more than 60 known sites in the region.

The entire history of sternwheelers and steam tugs in southeastern British Columbia lasted less than 80 years (Turner 1984). During this period this mode of transportation was instrumental in transforming a mountainous wilderness into a vibrant network of small mining communities and thriving cities and in doing so left a legacy of memories for the thousands of people who steamed along the lakes and rivers of this region in search of a new future.

ACKNOWLEDGMENTS

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Living Landscapes Program for their generous support. Additionally, the authors would like to extend their sincere appreciation to the members of the Kootenay Branch of the UASBC and the many local volunteers who have participated in this project.

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Major Steam-Era Wrecks and Associated Sites of the West Kootenays, British Columbia: Representative Sites

Introduction

Woodward and Pollack (this volume) provide an overview of the work of the Underwater Archaeological Society of British Columbia (UASBC) to document the wrecks and land sites in southeastern British Columbia, Canada. The project was initiated in 1989 by avocational underwater archaeologists who have since located 56, and mapped 14, sites.

An overview of history of the area and major known wrecks is presented elsewhere (Woodward and Pollack, this volume). This paper describes three significant wrecks and a land site associated with the Canadian Pacific Railway's (CPR) railway transfer network on Kootenay Lake. The lake extends 110 km north-south and connects to the 30 km long West Arm, which drains into the Kootenay River near Nelson, British Columbia. The wreck and land sites are located along the West Arm (Figure 1).

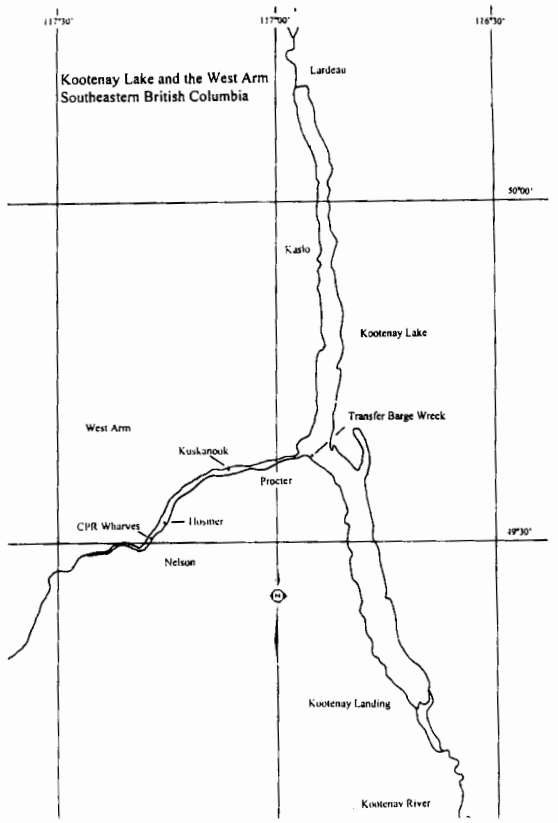

FIGURE 1. Kootenay Lake and the West Arm, Southeastern British Columbia.

1906 Sternwheeler *Kuskanook*

Specifications and History

The *Kuskanook* was the largest wooden-hulled sternwheeler built by the CPR in the interior of British Columbia with a length of 59 m, a beam of 9.4 m, and a hull depth of 2.1 m. It was rated at 1,008 gross tons displacement and constructed at Nelson by J. M. Bulger at a cost of $104,145 (Turner 1984; Affleck 1993). A main deck was surmounted by a saloon deck and a "texas" deck. A Polson Iron Works (Toronto) steam plant provided 32.3 nominal-horse-power (NHP) via two high pressure cylinders of 56 cm diameter and 2.49 m stroke.

The vessel served the "Crow Boat" route on Kootenay Lake, a 83 km gap in the intercontinental rail line in southeastern British Columbia. Rail passengers would travel on sternwheelers, while the railcars were transported on railway transfer barges towed by steam tugs. This system operated between Nelson/Procter and Kootenay Landing, until a connecting rail line was constructed in 1930.

The *Kuskanook* was replaced on the Nelson-Kootenay Landing run in 1913 by the new sternwheeler *Nasookin*. The vessel continued to

Underwater Archaeology, 1999:27–32.

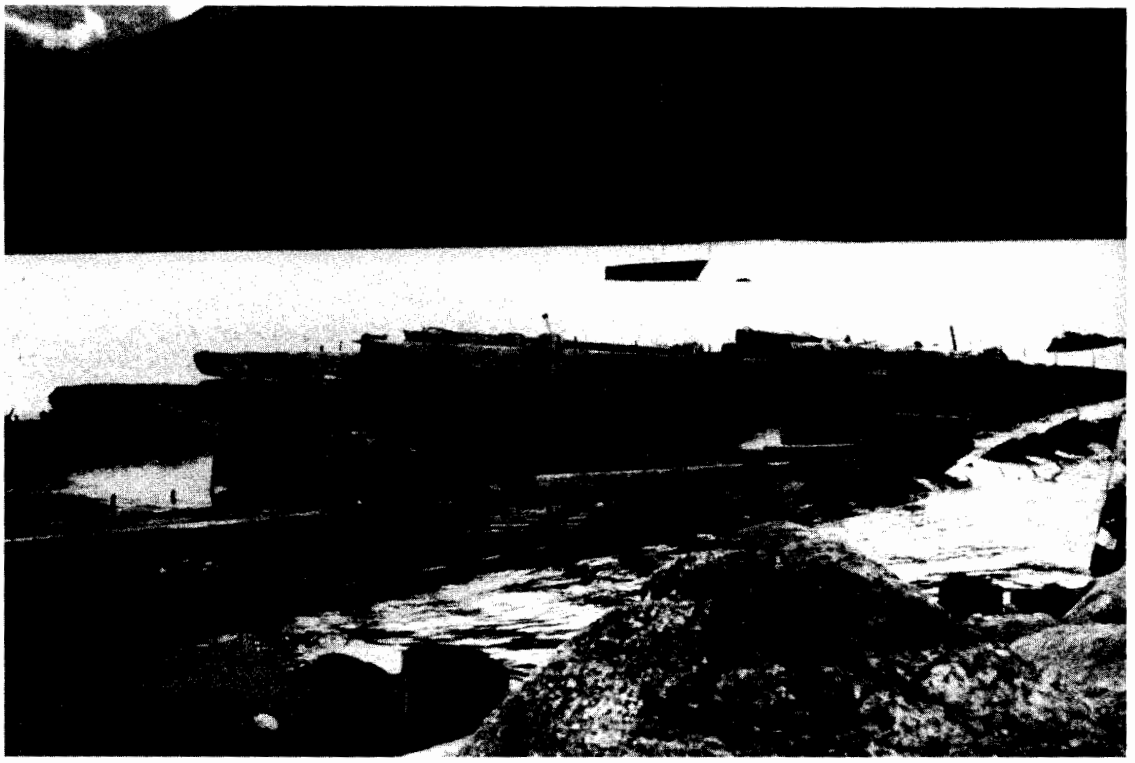

FIGURE 2. The *Kuskanook*.

serve as a relief vessel and in 1922 it replaced the sternwheeler *Kokanee* on the Nelson-Kaslo-Lardeau run

The *Kuskanook* was retired in 1931, stripped of equipment and sold. The vessel was moored at Kokanee Landing until 1936, when it flooded and broke its back.

Current Status

The *Kuskanook* lies in 1 to 3 m of water 24 km east of Nelson with the stern on shore and the bow in 3 m of water (Figure 2). The UASBC mapped the wreck in 1993 and worked with Butler and Pasemko (1993) who described the wreck for the British Columbia Heritage Trust. The superstructure, machinery, and paddle wheel are missing from the hull. From the bow to 10 m aft, the wreck is three-dimensional with the hull and deck beams intact, and some deck sheathing in place. From 10 to 60 m aft the wreck is three-dimensional with the keel and keelsons, frames and hull planking intact, but the deck beams and superstructure are missing. From 40 to 60 m aft the wreck is two-dimensional, with only the bottom portions of the frames and hull planking intact; in this area there is evidence of fire.

The wreck of the *Kuskanook* may be the sole example of a large, wooden-hulled sternwheeler of this construction type in Western Canada. Wood components are sound and the iron fittings show little rust. The clear water, good access, and state of preservation makes this wreck an excellent candidate for further work.

1909 Steam Tug *Hosmer*

Specifications and History

The *Hosmer* was the largest steam tug constructed on Kootenay Lake for the CPR barge service. Built in 1909 by J. M. Bulger in Nelson for $36,776, the vessel was 33.5 m in length with a 6.4 m beam, 2.6 m hull depth, and a displacement of 153.9 gross tons (Turner 1984; Affleck 1993). The wooden-hulled vessel was powered by a Scotch boiler and a steam engine with two vertical, compound (35 cm and 76 cm diameter) cylinders and a 51 cm stroke, driving a single, 4-bladed screw. The Polson Iron Works (Toronto) steam plant produced 36 NHP.

The *Hosmer* moved 15-car railway transfer barges between Procter and Kootenay Landing pushing two barges at a time while a barge man observed from a small pilothouse atop one of the barges. In 1925 its cabins and deck burned; the vessel was rebuilt with an additional deck to improve visibility from the wheelhouse.

The *Hosmer* was retired in 1930 with the completion of the Procter-Kootenay Landing railway connection. The engines were removed and the vessel towed to Bealby Point for use as a houseboat. Vandals burned the *Hosmer* to the waterline in the 1930s.

Current Status

The *Hosmer* lies awash 4 km east of Nelson, on the south shore of the West Arm, where it was surveyed by the UASBC in 1997. The hull bears evidence of fire and the deck beams and superstructure are missing. The wreck contains little machinery save for the boiler (Figure 3).

FIGURE 3. Boiler of the *Hosmer*.

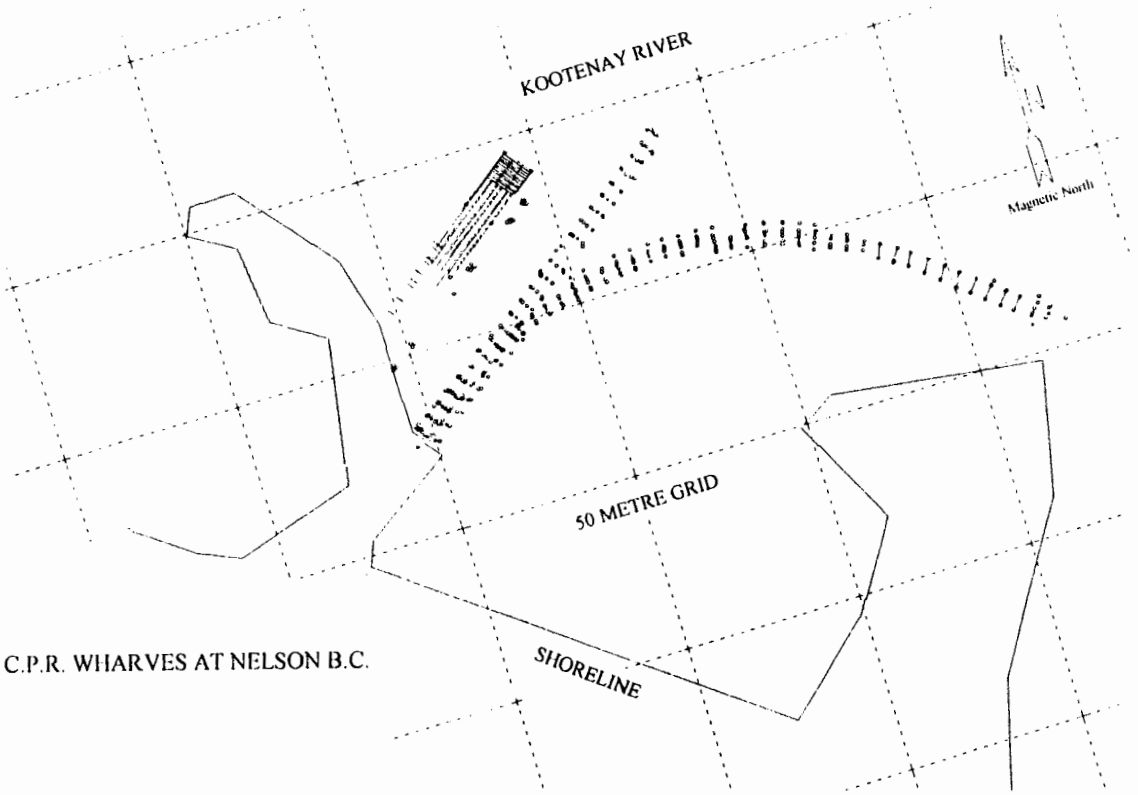

FIGURE 4. Canadian Pacific Railway Wharves at Nelson, British Columbia.

From the boiler forward the hull has collapsed outward, with the frames and planking pulling away from the stem piece, to lie horizontally on the lake bed.

Toward the stern the hull is three-dimensional; the outer hull is single planked and sheathed in iron. Frame spacing is variable, and frames are continuous in the vicinity of the engine. The removal of the shaft and propeller has broken two large sections of frames and planking away from the hull.

Immediately forward of the boiler are lengths of railway iron, presumably used as ballast, and near the stuffing box are large fragments of concrete. The 2.50 x 1.35 m rudder and steering arm lie in the mud approximately 20 m east of the stern. The propeller and shaft of the *Hosmer* are displayed at the Nelson City Museum; the propeller is 2.32 m in diameter with separately forged blades bolted onto the hub with bronze nuts. The *Hosmer* is the largest known steam tug wreck in the southern interior.

1901 Railway Transfer Barge Wreck at Procter

Specifications and History

The 15-car railway transfer barges on Kootenay Lake were some of the largest unpowered vessels built in the interior of British Columbia. Although records for CPR Barge No. 15 have not been found, it would have consisted of a 70 x

12.8 m, wooden flat-bottomed barge with a 2.4 m hull depth, and a displacement of 900 to 1,100 tons (Turner 1984). Six keelsons were located directly under the three sets of rails, to support three rows of cars. A hogpost and chainstay system was used on these vessels, and a pilothouse was located above the hogposts. Three clusters of hatches were placed in the deck to allow access to the hull between the keelsons.

Barge No. 15 transported loads of rail cars but not, as a general rule, locomotive due to their weight. In April 1901 the steam tug *Valhalla* left Kootenay Landing for Nelson with No. 15 in tow. The barge foundered when the voyage was half-completed, losing eight cars in the 130 m deep lake and carrying away the hogposts and chainstays on one side. The tug managed to push the sinking barge to shore where it lost the remaining seven cars. The barge was salvaged but the cars and cargo remained on the site.

Current Status

The site lies 30 km east of Nelson near the southern navigation light at the entrance of the West Arm. From a cobble beach, a steep rocky area descends to a depth of 25 m where a wall drops to depths in excess of 100 m. Four railcars are located at 8 to 13 m above the wall, in close proximity to each other. Car 1 is smashed and upside down with one wheel truck still attached on its eastern end. Car 2 is right-side up and immediately on top of Car 1. It was loaded with coke but has not remained intact. Both ends of the car are upright, but the southern side of the car failed, spilling its load. Car 3 lies to the west, upright on the bottom with a full load of coke, and without trucks. It is completely intact, except for missing roof planking. Car 4, also loaded with coke, is located to the north, upside down without side doors. Car 5 has plunged over the top of the wall, but stopped when one end wedged on a ledge; it is unloaded and intact. Car 6 is likewise intact but lies 290 m distant from the cluster of wreckage at the navigation light.

To date only five wheel trucks have been located, generally to the south of the cars. These assemblies consist of steel wheels and axles. The spring assemblies are jointed by large wooden cross beams of clear fir. The only evidence of the salvaged barge are several chainstays and fittings on a shoal near the navigation light.

The 1901 railway transfer barge wreck is the finest train wreck site found to date in the southern interior of British Columbia. The wreck offers a concentration of turn-of-the-century railway technology, in a striking setting.

Old CPR Railway Transfer Wharves at Nelson

Specifications and History

The site lies within the city limits of Nelson, adjacent to the airport. It was used by the CPR in 1898 as the original terminus of the "Crow Boat" route. Additional transfer routes also linked Nelson with Kaslo and the Lardeau on the northern portion of Kootenay Lake. While constructed for transfer barge traffic, the wharves lost much of this traffic after 1901 when the CPR built an alternate facility at Procter to bypass a narrow, high current bottleneck on the West Arm. The Nelson facility continued to be used for commerce and passenger traffic after this period, and in 1909 the CPR negotiated a lease with the City and expanded the wharves. The wharves became derelict by the 1950s.

Current Status

The present site covers an area 160 m by 200 m and is comprised of 360 piles and associated structures (Figure 4) which remain submerged except during low water. There are three separate docks or wharves. At the downstream end of the site is a heavy cribbed structure approxi-

mately 12 x 80 m. It supported three sets of rails that lined up with the rails on the transfer barges. Immediately offshore from this facility is a single boxcar and two sets of rail car wheel assemblies in 30 m of water.

Upstream of the barge facility are the pilings of two wharves—one long and curved and one straight—that intersect in the water and then continue onto shore. Some pilings near the airport have been destroyed, but the remains of the curved wharf are 200 m in length. Likely this wharf supported a single set of tracks to allow trains to make a circuit of the wharf facility without reversing. Some of the cross beams between pilings are still present. The curved wharf is intersected by a smaller linear wharf which may have supported a single set of tracks; this wharf is approximately 50 m in length

This site is the largest remaining steam-era transfer facility in the interior of British Columbia. The site was threatened by development in 1997 at which time the UASBC instituted a laser transit survey to record the location of the remaining pilings. During this project a large number of artifacts were noted in the area, including wheelbarrows, a base of a loading crane, tools, bottles, and ceramics. A second boxcar wreck was located in 34 m of water upstream of the wharves during a side scan sonar search. Three additional wrecks are reported, but are as yet undiscovered, in this area.

Conclusion

During the nine-year-old Southern Interior Shipwreck Inventory, a wealth of undocumented steam-era sites have been located by the UASBC. This paper provides a description of four representative sites on Kootenay Lake, each of which is significant provincially or nationally, and yet are largely unknown to the professional community. When viewed collectively they present a picture of a unique inland maritime transportation system for which key wrecks and sites are still largely intact.

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Whaling and the Expansion of the University of Hawaii Maritime Archaeology and History Program into the Pacific

In 1819 two American whaleships, the *Balaena* from New Bedford and the *Equator* from Nantucket, took a whale off the Island of Hawaii, what many today call the Big Island (Starbuck 1989[1878]:225). This was the recorded introduction of Euro-American whaling methods into the Pacific. According to a report from the Honolulu Almanac of 1880, the ships arrived at Kealakekua Bay on 17 September 1819 and captured a sperm whale in that area that yielded 102 barrels of sperm oil (Thrum 1879:9). Kealakekua Bay is better known as the bay where Captain Cook, the Englishman credited with the European discovery of the Hawaiian Islands, was killed in 1779. Over the next century hundreds of ships recorded thousands of voyages from whaling ports such as New Bedford and Nantucket, Massachusetts, to the Pacific Ocean and the islands scattered within.

From the quiet beginning of two whaleships in 1819, the numbers rose dramatically for Hawaii. The two main harbors for whalers were Lahaina, Maui, and Honolulu, Oahu. There were 104 visits in 1824, 198 in 1832 and over 500 in 1846 (Mrantz 1976:9). According to statistics, 140 whalers arrived in Lahaina in one month alone, November 1843 (Thrum 1912:7). One hundred thirty-two of these were American, three were from Bremen, three from London, and one each from Sydney and St. Johns, New Brunswick (Thrum 1912:7). In 1844 the value of the cargo for the 326 vessels arriving in Lahaina was $16,761,140 (Thrum 1912:8). This coincides with information from the New Bedford whaling fleet, showing a marked increase in the percentage of whalers sailing to the Pacific rather than Atlantic and Indian or Arctic Oceans.

Around 1833 the first Hawaiian-registered whaling ship began plying the Pacific. Hawaiian interest in the trade lasted until 1880 ("Hawaiian" here refers to the foreigners and Euro-American denizens who controlled most of the business in Hawaii at this time). This can be seen in the names of the ships' owners from contemporary accounts. According to a report in the Hawaiian Annual,

> "Honolulu's fleet of whalers and traders in 1856 consisted of two ships, three barks, six brigs and three schooners, representing the enterprise of Allen & Co., Captain Chester, R. Coady & Co., J. M. Green et al., Hoffschlaeger & Stapenhorst, Jason Makee & Co., Melchers & Co. and C. A. Williams & Co." (Thrum 1912:52).

Native Hawaiian men often secured employment on whalers. David Chappell (1997:xiii) writes, "By the mid-nineteenth century, perhaps as many as one-fifth of the sailors in the American whaling fleet were [Hawaiians]." In fact, whalers hired many ethnic groups to work on the long journeys, from Native and African Americans to Polynesian, Melanesian, and Micronesian islanders. These men occupied all positions on the ship, from unskilled laborer to harpooner and cooper. For example, in the book, *Whaling Will Never Do For Me,* Briton Cooper Busch (1994:33) notes, "On whaleships, blacks served as cooks and stewards, but they were also foremast hands, and sometimes were found as skilled craftsmen aboard, such as coopers, sailmakers, or blacksmiths."

In the beginning, Pacific Islanders would have mostly occupied the unskilled positions prevalent aboard whalers. With the increase of whaling in the Pacific, and the need to replace seamen during the long voyages, many Pacific Islanders who may have started out as unskilled, quickly graduated to the higher-paying skilled jobs. This is particularly true for Hawaiians and the Maori in New Zealand. There are accounts of whalers crewed entirely by Polynesians, including the captain. Chappell (1997:15-16) writes, "Whaleships like the *Governor* and the *Chance*

Underwater Archaeology, 1999:33–38.

were Maori-operated and competed effectively with foreign vessels, as did Maori schooners trading for sandalwood, tortoise shell, and beche-de-mer. . . ."

By 1859 the number of Hawaiian-registered whaleships had increased to 20. This was also a "high water mark" of whaling in Hawaii with 549 arrivals of whalers at all ports (Thrum 1912:54). This coincides with the discovery of petroleum in Pennsylvania in the 1850s and its applications as fuel in the form of kerosene for the lamps that formerly used whale oil. The discovery of an alternative fuel source was the first and arguably most influential of several major calamities to the 19th-century whaling industry. There were also incredible losses during the American Civil War through the sinking of many whaleships as part of the stone fleet designed to blockade Savannah and Charleston harbors, and the destruction of a number of whaleships mainly by the Confederate raider CSS *Shenandoah*. Finally, the destruction of the last large whaling fleet in 1871 due to an early freeze in the Arctic all but destroyed whaling as an industry in the age of sail (Mrantz 1976:36). In 1860, one year after that "high water mark," the number of whalers in Hawaiian ports was down by 224 ships (Thrum 1912:55).

What kind of legacy did whaling ships and the whaling industry leave behind? According to Mark Twain, writing from Honolulu in 1866, whaling provided the means of existence for Honolulu. "Shorn of it this town would die," he writes, "its business men would leave and its real estate would become valueless, at least as city property, though Honolulu might flourish afterwards as a fine sugar plantation, the soil being rich, and scarcely needing irrigation" (Twain 1939[1866]:58). Twain's account is rather off the mark as anyone who has recently been to Honolulu can attest. Indeed by the time Mark Twain visited the islands many of the industries that would bring Hawaii into the 20th century were already well in place. The first sugar plantation was begun on Kauai in 1835. The provisioning of whaleships in Hawaiian harbors played a major role in the development of agricultural production and the growth of a cattle industry and large mercantile houses. Today's tourism industry calls upon the history of whaling to entice people into museums and shopping centers.

A long term goal of the University of Hawaii (UH) Maritime Archaeology and History Program is the expansion of research and field work beyond Hawaiian waters. This will enable UH researchers to study industries and regional socioeconomic patterning in addition to the study and documentation of isolated wrecks. The program's current large-scale focus is a study of inter-island landings around Hawaii. Whaling could be the focus of a future project.

From an archaeological perspective the whaling industry offers many opportunities. It is here that the idea of looking beyond the Hawaiian islands first took shape. Whalers anchored in nearly every possible harbor in the Pacific, from the frozen waters of the Antarctic to the equally frozen seas of the Arctic and Okhotsk. One potentially profitable place to look for the remains of 19th century whaling ships are harbors widely used by whalers during the 19th century that are no longer in use. Ideally, harbors that have seen little or no 20th-century shipping would be the best places to look. Here is where Pohnpei in the Federated States of Micronesia comes into focus.

Three thousand miles west of Hawaii, lying at about 7° north of the equator, is the island of Pohnpei (Figure 1). It is the third largest island within the area known as Micronesia, as opposed to the islands of Polynesia to the south and east, and the islands of Melanesia to the south and west. Historically, Pohnpei was known as Ponape, a bastardization of the traditional name given the island by the Pohnpeians. Pohnpei is also known in historical accounts by the names Ascension, Bonabe, and Senyavin (Hanlon 1988:xiii).

Pohnpei was a popular rest stop and watering hole for whalers and traders during the 19th century. What is especially significant for modern research and archaeology is that the harbors used

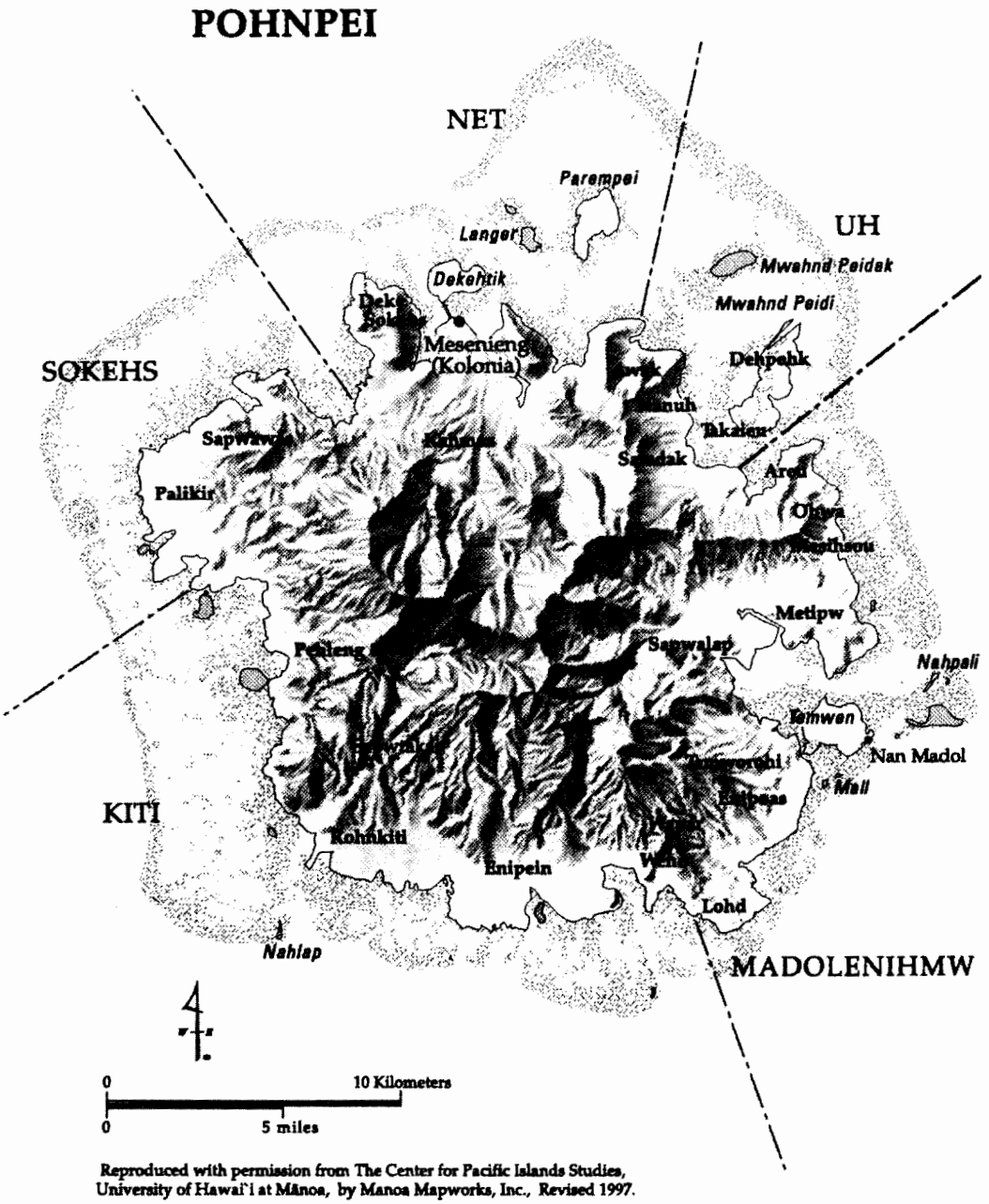

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FIGURE 1. Map of Pohnpei, Federated States of Micronesia.

during this time are not those used in modern times. From the first colonial influence of the Spanish in 1885 to the present, the main harbor used is next to the capital, Kolonia, along the northern end of the island. This was not a popular destination for whalers and traders who preferred the harbors along the southern end of the island.

During their rule, the Spanish lamented that they could not control what was going on among the whalers and traders within the southern harbors because they had no access to them. During their brief period as colonizers, from 1885-1899, the Spanish mostly kept to the capital, where they built a huge wall around the colony to protect themselves from the Pohnpeians with whom they occasionally warred (Hanlon 1988:xiii). In 1899 the Spanish sold these colonies to the Germans who held them until 1914 when they were transferred to the Japanese. The Japanese did chart the southern harbors, but there is no indication that any of these colonial powers used the harbors for regular traffic, if at all. Nor is there evidence of extensive American activities there after 1945, when the area became part of the Trust Territory of the Pacific Islands, until Micronesia's independence in 1981.

The southern harbors of Rohnkiti, Pohnatik, and Madolenihmw were used extensively during the 1800s. These harbors cannot support the large fishing vessels and transport ships arriving from throughout the Pacific Rim today. Nor is it feasible to transport goods over land from these harbors to Kolonia. The road that winds around the island is still not completely paved. So from the early 1800s to the present, the only heavy use of these harbors by non-native vessels was the whalers and traders who visited them in the 19th century. This opens the way for some theorizing on what might be found there.

Eleven ships are listed in the historical record as lost in the harbors of Pohnpei. The first is the *Falcon,* a British whaler, caught on a reef near Nahpali island in Madolenihmw in 1836 (Hezel 1979:41; Hanlon 1988:50-58; Carrell 1991:120). Much of this wreck was salvaged. The *Miantonomi*, wrecked in 1854, was a New Bedford whaler. It wrecked when its crew, stricken with small pox, could not summon the strength to keep it off the reef (Clement 1854; Carrell 1991:122). It was salvaged at the time and burned to the waterline (Clement 1854). Another whaler tried to salvage its anchor a year later but was apparently unsuccessful (Hezel 1979:60). An unidentified trader wrecked in 1860, according to a missionary report, but there is no other information about this vessel (Hezel 1979:69).

In April 1865 the CSS *Shenandoah*, sailing north from Melbourne, Australia, captured and burned four whaling ships in Madolenihmw at Pohnatik Harbor (Hezel 1979:72; Carrell 1991:122). Three of the four ships, the *Edward Carey*, *Hector*, and *Pearl* held American registry. The fourth ship, the *Harvest*, actually held Hawaiian registry but there was some doubt as to its ownership at the time, so it was burned with the rest. In 1870 the *Malolo* sank (Hezel 1979:76). The *Malolo* was owned by the notorious trader, Captain Benjamin Pease. His exploits are now well-chronicled in the annals of Micronesian history, though not in the favorable light he would have wished (Hanlon 1988).

The *Kamehameha V* from Hawaii came to Pohnpei in 1865 and rescued the stranded sailors from the four whalers sunk by the CSS *Shenandoah*. In 1873 it too wrecked at Pohnpei (Hezel 1979:79). Some of the material from this wreck was salvaged in 1874 by the notorious blackbirder and suspected pirate, Bully Hayes (Hezel 1979:80). This was the same year an unidentified whaler was recorded as laid up and too leaky to sail (Wood 1875:174). This is the only wreck identified in the northern part of the island. The last recorded wreck occurred in 1880 when the American trading schooner *Undine* wrecked at Madolenihmw in early February (Hezel 1979:84).

It is hard to infer just how much material data might be left from any of these wrecks. There is a much greater chance of finding materials from the hundreds of whalers that anchored at

Pohnpei. To date the only underwater survey at Pohnpei was as part of a National Park Service (NPS) submerged cultural resources assessment in the early 1990s. There is no published information about this survey, but a January 1999 conversation with Daniel J. Lenihan, chief of the NPS's Submerged Cultural Resources Unit, indicates that some cultural material was located at Pohnpei and is from a suspected whaler (Daniel J. Lenihan 1999, pers. comm.) The identity of this ship is something that could be confirmed with further research. There is a good possibility that an underwater survey of the most frequented harbors of Pohnpei will yield some interesting and useful information about the activities of whaleships in foreign waters.

Whaling was unique in many ways. The ships were gone from home port for up to four years, making the procurement of goods along the way, especially wood and water, a necessity. The processing of the whale, from the hunt to the storage of oil in barrels or casks, meant that each ship had to carry the tools to hunt the whale, butcher the whale, process the whale, and store the finished products. This meant outfitting the smaller whale boats with all the implements needed to hunt the whales and survive if the boats were separated from the ship or if the ship was wrecked. It also meant building and maintaining the brick try works on board the main ship that processed the whale blubber into oil. Coopers were on hand to build the barrels and casks needed during the voyage, filling every nook and cranny of the holds if need be with storage containers. Carpenters, meanwhile, repaired the ships and whale boats during the arduous trips. Ships sometimes carried enough materials to practically build a new vessel in case the old one wore out. There was a plethora of items carried on board a whaler and as the voyage progressed, items broke, wore out, or fell overboard. These are the items researchers will most likely find in harbors where hundreds of ships anchored for days, weeks, and months repairing broken materials and throwing out what could not be fixed.

There is, of course, other material that would be found on a whaler but would not be as diagnostic as whaling implements. For example, domestic supplies such as utensils, kitchen aids, and plates were always in use and thus in danger of breaking and wearing out. Dishes and jugs of the era were made of earthenware, stoneware, and porcelain. Ceramic fragments are also a likely remnant of long-term anchorages and are an important medium for determining age and origins of larger groups of artifacts.

From this overview of shipwrecks and ship activities at Pohnpei, a few generalizations can be made concerning the historic record and the potential for archaeological investigations in Pohnpeian harbors:

1. The potential for cultural materials within the harbors, particularly those in the southern provinces of Madolenihmw and Kiti, is high. What makes this likely is the continuous movement of provisions, trade goods, and personnel from the ships at anchor in the harbor to the shore in smaller boats. The movement of goods over the side of the ships into the boats, the movement of the boats through water, and the movement of materials from the boats to the shore are three areas with a potential for accidents and spills.

2. Those cultural materials may come from the 11 ships wrecked in the harbors. Although much of this material would have been stripped from the ships at the time of the wreck, large items such as anchors or trypots would have been much more difficult to move. These larger items also have a good likelihood of surviving underwater for 100 to 150 years.

3. More likely, however, materials found within the harbors will come from day-to-day activities of the ships anchoring rather than the few ships that wrecked there. The travel of small boats to and from shore, the repair work undertaken on board ship whenever time permit-

ted, and the everyday refuse thrown overboard provides a host of opportunities for cultural remains to end up along the bottom.

So what does the future hold for the study of whaling at Pohnpei? At the moment the key question is, where will the money come from? The UH Program is working to secure funding to mount a small preliminary survey of several of the harbors in August 1999. Using equipment on loan from the University of Hawaii Marine Option Program (MOP), researchers will document the known cultural materials with still photography and video footage. This information will then be available for review on the MOP web site (see http://www2.hawaii.edu/mop). Researchers will use an underwater metal detector, hand-held Global Positioning System (GPS) unit, and ethnographic data to locate additional material. The justification of a full-scale field school or research project at Pohnpei will only come from clear evidence that there is enough material to warrant further investigation.

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New Roles And New Directions In Underwater Archaeology: Update On The United Kingdom's Archaeological Diving Unit (ADU)

Introduction

The Archaeological Diving Unit (ADU) is a team of diving archaeologists who are currently contracted to the United Kingdom's Department for Culture, Media, and Sport (DCMS). Based at the Scottish Institute of Maritime Studies at the University of St. Andrews in Scotland, they provide expertise and advice to those government agencies responsible for shipwreck archaeology in England, Scotland, Wales, and Northern Ireland.

At the completion of their initial five-year contract a paper was presented at the 1991 SHA conference reviewing the work of the ADU (Oxley 1991). With the completion of their second contract, and the successful negotiation of a third in the spring of 1998, it seemed an appropriate time to present a second update outlining the Unit's progress.

Background

The ADU was established in 1986, initially under contract with the Department of Transport. Its purpose was to assist with the implementation of the 1973 Protection of Wrecks Act. At the time this Government Department and its Advisory Committee on Historic Wreck Sites had come to the conclusion that there had been an overall failure to effectively implement the Protection of Wrecks Act, and it was decided that a team of professional diving archaeologists was needed. The ADU works closely with the Advisory Committee on Historic Wreck Sites, and collaborates with the Joint Nautical Archaeology Policy Committee, and the Nautical Archaeology Society.

Since its inception, the primary duties of the ADU have included: (1) the on-site evaluation of wrecks proposed for designation; (2) the monitoring and assessing of impacts affecting previously designated wreck sites; (3) the offering of advice and assistance to those who hold a license to conduct investigations at a designated wreck site as well as the monitoring of these investigations to assess their value when completed; and finally, (4) to assist those heritage organizations across the United Kingdom who are responsible for shipwreck archaeology (Oxley 1991:58).

In addition to these duties, the Unit is beginning to carry out active searches for wreck sites in areas where they are suspected to be found. This is the result of the ADU's commitment to improve and expand its underwater effectiveness in such areas as magnetometer and side scan sonar surveys, integrating these functions with accurate Differential Global Positioning System (DGPS) navigation and mapping. In 1999 a new sonar system will be employed to track and direct the movement of a diver while on-site. This will facilitate investigations carried out in areas of very poor visibility.

In 1998 the Unit began a five-year charter of a new research vessel, the *Scimitar,* a 33-ft. Blyth catamaran. The *Scimitar* is well suited for supporting a wide range of underwater archaeological investigations and is a vast improvement over the Unit's previous research vessel.

Health And Safety Regulations

Over the last three years the ADU has been active in the areas of health and safety regulation and professional accreditation. Previously, when underwater archaeologists worked in the United Kingdom they had to follow the same stringent health and safety requirements as a commercial diver who worked on a North Sea oil platform. In 1996 the Unit was involved with the formulation of a new code of practice designed specifi-

Underwater Archaeology, 1999:39–45.

TABLE 1
LIST OF PROTECTED WRECK SITES

1. Cattewater Site (1530)
2. *Mary Rose* (1545)
3. *Grace Dieu* (1436)
4. *Amsterdam* (1749)
5. *Mary* (1675)
6. *Assurance* (1738) & *Pomone* (1811)
7. *Anne* (1690)
8. Tearing Ledge Site (1707)
9. Rill Cove Site (1606)
10. South Edinburgh Channel Site (18th century)
11. Church Rock Site (16th century)
12. Pwll Fanog Site (no date)
13. Moor Sand Site (Middle Bronze Age)
14. *Coronation*-inshore (1691)
15. *Kennemerland* (1664)
16. Langdon Bay Site (Middle Bronze Age)
17. *Tal-y-bont* (1677)
18. *Stirling Castle* (1703)
19. *Invincible* (1758)
20. Bartholomew Ledges Site (late 16th century)
21. *Northumberland* (1703)
22. *Restoration* (1703)
23. *St. Anthony* (1527)
24. *Schiedam* (1684)
25. Brighton Marina Site (16th century)
26. Yarmouth Roads Site (16th or 17th century)
27. Studland Bay (1520s)
28. *Admiral Gardner* (1809)
29. *Hazardous* (1706)
30. *Coronation*-offshore (1691)
31. *Iona II* (1864)
32. Gull Rock Site (15th or 16th century)
33. *Wrangels Palais* (1687)
34. Erme Estuary Site (16th to 18th centuries)
35. The Smalls Site (1100)
36. Duart Point Site (1653)
37. *Dartmouth* (1690)
38. *Girona* (1588)
39. *Royal Anne* (1721)
40. Erme Ingot Site (no date)
41. Dunwich Bank Site (1672)
42. *Resurgam* (1880)
43. *Hanover* (1763)
44. Seaton Carew Site (no date)
45. Salcombe Cannon Site (1630-1640)
46. *A-1* (1911)

cally for scientists and underwater archaeologists. The Health and Safety Commission issued this new code of practice in 1998 and it makes it easier for professional archaeologists to work along side amateur divers on projects where they could not do so before.

The ADU has also been working with the Institute of Field Archaeologists (IFA), an organization formed in 1982 to promote professional standards and ethics in archaeology as a whole. One of the Unit's staff helped to produce an IFA Technical Paper which outlines a variety of methods for approaching and investigating marine sites (Oxley and O'Regan 1999).

Secretary of State's Advisory Committee on Historic Wreck Sites

Over the last six years the overall structure and administration of the ADU has changed very little. However, an important change did occur when the new Department for Culture Media and Sport took over responsibility for heritage. This was soon followed by a change in the structure of the Secretary of State's Advisory Committee on Historic Wreck Sites with whom the ADU works very closely. The Unit provides information and advice to the Advisory Committee which is responsible for making recommendations to the Secretary of State concerning a wreck's possible designation. The Advisory Committee is also responsible for issuing licenses to allow an investigation at a designated wreck site.

Previously, the Advisory Committee consisted of a self-perpetuating body whose membership seldom changed. This resulted in a long-term stagnation of ideas and viewpoints. In 1996 several members of the Committee were removed, a constitutional structure was adopted, and a system of rolling membership was initiated. These progressive changes were brought about by the new chairperson of the Committee, Lady Maureen Merrison, and they have had a positive effect on the overall process of wreck management in the United Kingdom. The new members of the Committee are forward looking and more accept-

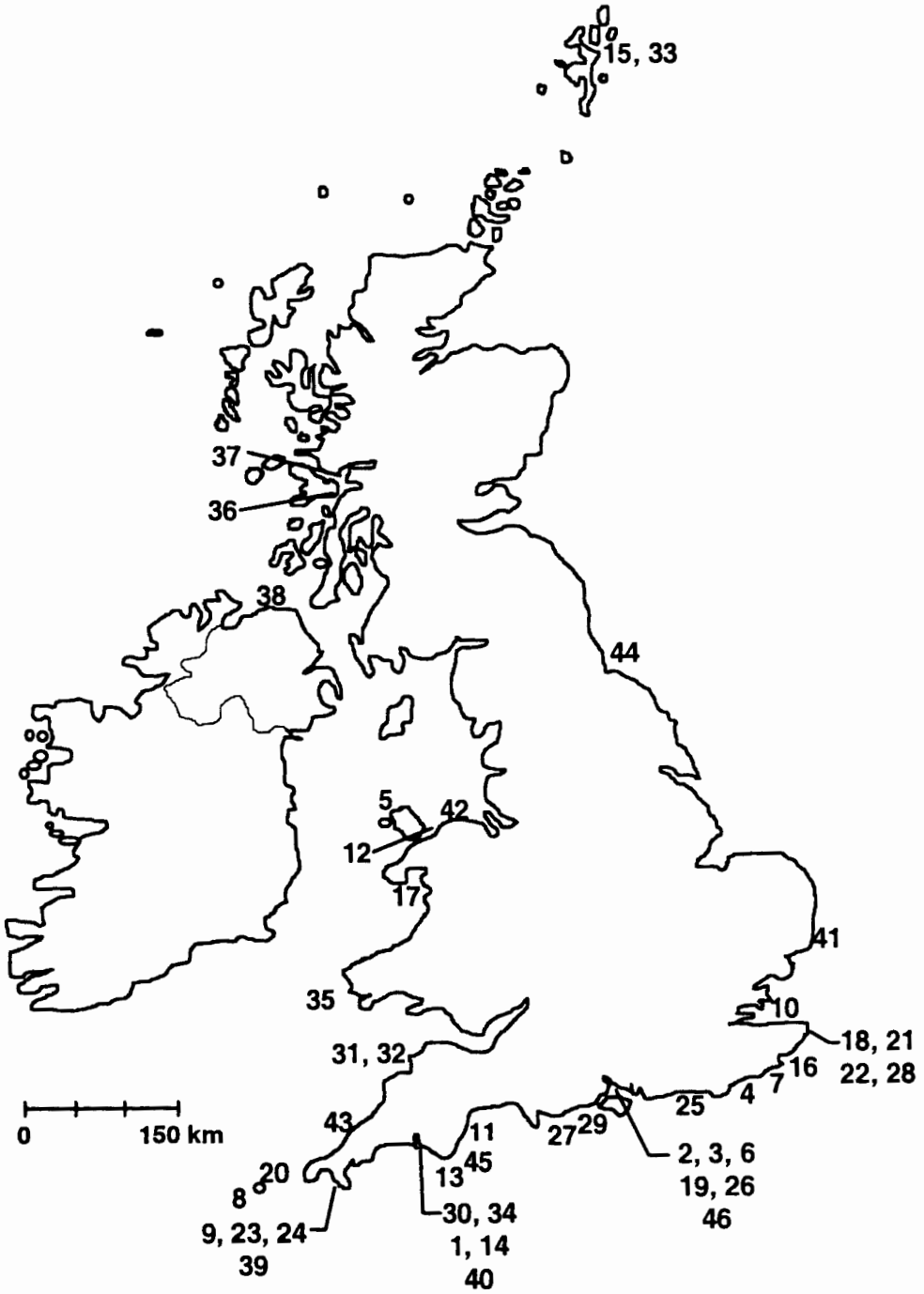

FIGURE 1. Distribution Map Showing Protected Wreck Sites in the United Kingdom.

ing of advice from the archaeological community. The ADU has found that this new system is much more responsive when urgent management issues arise.

The ADU in Action

Since 1991, the number of designated wreck sites has grown from 33 to 46 (Table 1). The latest site to be designated is the wreck of the submarine HMS *A-1*, lost off the south coast of England in 1911. The overall distribution of designated wreck sites has remained the same, with only a slight shift towards the southwest coast of England, the west coast of Scotland, and the first site to be listed in Northern Ireland, the wreck of the *Girona,* a Spanish Armada *galleass* (Figure 1). This distribution, which heavily emphasizes the southern coast of England, is a reflection of those areas favored by sport divers, and does not reflect any specific patterning of past maritime activity.

On the contrary, historical documentation clearly indicates that wrecking events occurred consistently throughout the coastline of the United Kingdom. One example is a wreck chart published by the Royal National Lifeboat Institution in 1877 which indicates a wide-spread distribution of wrecking events for that year (Dean et al. 1995). Based on this and other sources of information, it has been estimated that there may be over 500,000 wreck sites in the United Kingdom. The Royal Commission on Historical Monuments of England alone has generated a Maritime Record with a listing of over 30,000 shipwrecks and areas of archaeological importance (Oxley 1996).

Of the 13 newly designated sites the Duart Point wreck and the wreck of the *Resurgam* are two case-studies which highlight some of the current activities of the ADU. The Duart Point wreck is located on the west coast of Scotland at the southeastern entrance to the Sound of Mull. In 1991 John Dadd, a naval diving instructor, reported the wreck to the ADU who visited the site later that summer (Martin 1995:41). Finds previously recovered by Mr. Dadd and the ADU's own observations suggested that the wreck dated to the mid-17th century. It was recommended to Historic Scotland, the national regulatory authority involved, that the site be designated under the Protection of Wrecks Act. This was done in 1992.

A subsequent visit by the ADU the following year indicated that the wreck was suffering from extensive destabilization as the result of an aggressive local tidal regime acting upon vulnerable sediments located across the site. It also was discovered that a local diving club had recently removed a number of artifacts (Martin 1997:169). A week-long rescue operation was quickly organized by the ADU and the National Museums of Scotland with the aim of mapping and raising the remaining exposed artifacts which were under threat. Subsequent analysis of these materials and archival investigations strongly suggest that the Duart Point wreck is that of the *Swan*, a pinnace of approximately 150 tons which was part of an ill-fated Cromwellian expedition to Mull in 1653 (Martin 1997:179).

Dr. Colin Martin at the University of St. Andrews has been directing the research of the Duart Point wreck since 1993. A full survey and site assessment has now been completed. A continuous program of site monitoring has also been initiated to actively monitor and assess the condition of the site and to determine the most appropriate conservation strategy.

Two of the conservation measures which have already been initiated are the attachment of sacrificial anodes to the exposed canons and the use of sandbagging to temporarily protect the site against the aggressive tidal regime of the area. This summer a more extensive excavation project is planned. This is the only full-scale excavation currently being undertaken by a professional diving archaeologist in the United Kingdom at a designated wreck site.

The Duart Point Wreck is a good example of the present cultural resource management system working at its best. A site was found by local divers, it was reported to the proper authorities

who responded in a timely manner, it was assessed and designated, a team of dedicated professionals was assembled to study and conserve the site, and the research that has been conducted has been widely published. The Duart Point Project is also the first site where conventional archaeological funding normally used for land sites was put into underwater archaeology by Historic Scotland. Unfortunately, there are not more of these types of cases to point to.

The second case-study involves a project where the ADU actively directed an archaeological investigation. This project, called SUBMAP, involved the survey of the world's first powered submarine, the *Resurgam*. It also exemplifies the Unit's continuing efforts to educate the wider diving community about shipwreck archaeology and maritime preservation.

The *Resurgam* was designed by the Reverend George W. Garrett, and was launched in November 1879 at Birkenhead near Liverpool. The British Navy expressed an interest in conducting sea trials near Portsmouth, and in 1880, as the *Resurgam* was being towed near the north coast of Wales it was caught in a violent storm and lost. Over the years the descendants of George Garrett remained actively involved in numerous attempts to find the lost *Resurgam*. William Garrett, the great-grandson of the Reverend, was the most active in this search, and in 1996 he helped finance a project with the assistance of the ADU.

Mr. John Perry Fish of American Underwater Search and Survey, Ltd. was part of the investigation and he was able to relocate the wreck using state of the art side scan sonar equipment. The vessel was found lying on its starboard side at a depth of approximately 50 ft. The side scan imaging of the wreck was so detailed that it even recorded a gravel anomaly created as a result of the wreck's influence on the local environment.

With the site's relocation the ADU was able to carry out an official site assessment. It was recommended to the Advisory Committee that the site was of historic interest and should be designated for protection.

The following year the ADU organized SUBMAP, a two week archaeological investigation of the *Resurgam* which was aimed at gathering additional information to help formulate a management plan for the wreck. SUBMAP also provided a means to introduce and educate the wider diving community to the principles and techniques of underwater archaeology. The success of SUBMAP can be measured in the fact that over 100 amateur divers and 40 professional archaeologists and scientists were involved with the project.

SUBMAP not only succeeded in recording the wreck but also created an atmosphere of cooperation and understanding between professionals and amateurs. Those who were involved with the project have now gone on to set-up their own non-intrusive investigations at several other sites. This cooperative effort has resulted in these groups being much more likely to report the discovery of a new wreck site to the ADU with whom they are now familiar.

The Duart Point Wreck and the SUBMAP project are both good examples of the ADU in action-one highlighting the overall maritime heritage process and the other showing involvement in public education and awareness. Because of the success of SUBMAP the ADU has recommended to the government that it be allowed to formally run more projects that include the sport diving community in order to educate them concerning shipwreck preservation.

Evaluation

In assessing the performance of the ADU over the last six years it would have to be stated that they consistently exceed the scope of their contractual obligations with DCMS. In addition to their required duties, the Unit is continuing to improve its capabilities to conduct underwater archaeological assessments despite the

government's minimalist approach. The ADU is also fostering a positive relationship between professional archaeologists and the sport diving community. Public education and awareness should become a new mandate of the ADU, but again the government seems reluctant to expand the scope of the Unit's contract. Although their new contract with DCMS has limited the time spent teaching at the University of St. Andrews, the members of the ADU allow students the opportunity to ask questions and to observe their work first-hand.

Another positive result of their work is a general shift away from amateur projects aimed at excavation to those which focus more on survey, which is much less intrusive (Oxley 1996). However, more work needs to be done to educate the diving community and to encourage the reporting of finds. There is still no statutory requirement to report information concerning submerged wreck sites and it is left up to the good will of sport divers and fishermen to inform the ADU when a new wreck site is found.

If there is any failure that needs to be addressed, it is in the system and not with the Unit itself. With over 500,000 estimated wreck sites located within the United Kingdom's jurisdiction, the fact that only 46 are offered any type of active protection is a great disappointment. Although there are a number of organizations involved in coastal and marine management there is no system for consistent integration. In many cases the responsibility for cultural resource management falls on the shoulders of local authorities whose resources are quite limited. It is clear that the United Kingdom government views shipwreck preservation as a low priority. If Britain does not re-assess its commitment to protecting its archaeological maritime heritage, then it is in danger of losing a significant proportion of its overall cultural heritage. Any progress that has been made in the Unit's effectiveness has been the result of professional self-motivation and not the result of increased government support.

Another disturbing development is DCMS's reluctance to pursue prosecution of those who violate the Protection of Wrecks Act. Recently two groups of divers were caught illegally diving on the Salcombe Cannon wreck. Unfortunately, the local police authority was ignorant of the law and the end result was no charges being brought against the violators. This has subsequently angered those licensees who do follow the rules. Although incarceration is probably not warranted in most cases where sport divers are involved, some type of sanction must be levied or the wrong message is sent to the public.

The need for further, broad-based public education is clear. Dispelling the popular myths concerning shipwrecks, their worth, and the role of historic preservation legislation continues to be a major battle for archaeologists. In the October issue of *Diver*, Britain's best-selling dive magazine, an article by Rex Cowan clearly characterized the new UNESCO proposals for regulating historic shipwrecks as an immediate threat to diver freedom. This is not the case, but the wider diving community will not hear the other side of the story unless archaeologists effectively respond to such misleading statements.

The Future

In the near future the responsibility for the Protection of Wrecks Act and the administration of the ADU will be removed from the administrators at DCMS and passed on to the archaeologists and cultural resource managers at English Heritage. This shifting of responsibility from disinterested administrating civil servants to dedicated professionals should have a positive impact on the current underwater cultural resource management system. Unfortunately, this change requires an act of Parliament because the statutes of English Heritage prohibit involvement in anything below low watermark. Given the fact that the current government considers shipwreck management and preservation a low priority, it will

probably be some time before this issue is brought to the floor.

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Navy Aircraft as Artifacts

Introduction

Aircraft are the machines of our recent past. Navy and Army Air Corps aircraft were mass-produced by the thousands during World War II. Once plentiful, they are becoming increasingly rare as their historical significance grows. Military aircraft wrecks, particularly those from World War II known as "Warbirds," are highly sought after by museums, collectors, and salvors, and thus are extremely threatened wreck sites. The Navy, represented by the Naval Historical Center (NHC), has found itself as one of the leaders in aviation archaeology and the preservation of historic aviation resources. How the NHC came to be involved in protecting and preserving aircraft wrecks is the subject of this paper.

Scope of Resource

It is difficult to calculate the total number of Navy aircraft wrecks. The Navy has over 35,000 Aircraft Crash cards for World War II. However, many crash reports refer to aircraft that were repaired, removed, scrapped for parts, or otherwise eliminated. Therefore, each of these records requires scrutiny. After many grueling hours, NHC personnel estimate that about 12,000 Crash cards could represent extant terrestrial and submerged Navy aircraft wrecks. The number of surviving wrecks is less, due to subsequent destruction by environmental and human factors.

Development of Policy

The NHC, in developing its Underwater Archaeology program, believed that its primary focus would be shipwrecks. Requests from salvors and museums alike soon made it apparent that naval aircraft from World War II and earlier were hunted intensely and that they rivaled shipwrecks as management concerns (Cooper 1994:134-39). Reports of aircraft recoveries, both real and imagined, came from numerous locations in the U.S. and the distant Pacific. The NHC was forced to actively pursue the archaeology of naval aviation by the competing demands of aviation museums, salvors, and the resulting immediate threats to the preservation of the underwater remains of Navy aircraft (Whipple 1995:10).

Before World War II aircraft reached the 50-year threshold date for National Register consideration, Navy aircraft wrecks were dealt with as surplus equipment that must satisfy the legal requirements for disposal of federal property, demilitarization of weapons systems, munitions, and human remains. A Naval Air System Command Fact Sheet of May 1987 (United States Navy [USN] 1987) states that Navy aircraft belong to the Government of the United States until the Navy determines their disposition. Disposition, as defined in the fact sheet, can be "recovery, loan or donation to a qualified organization, or sold either intact or as scrap" (USN 1987). The fact sheet provided the possibility of public sale through the Defense Reutilization and Marketing Service (DRMS), but stipulated there were no assurances that any located and identified aircraft will be offered for public sale.

The 1987 memorandum illustrates that the Navy was already engaged in defending its title to wrecked aircraft well before the NHC became involved. Two examples include a TBF Avenger recovered off the Florida coast in a mistaken belief it was from the lost Flight 19, and a stripped and burned Helldiver recovered from Lake Washington, in Washington State. Also in the 1980s, two part-time salvors began finding Navy aircraft in Lake Michigan. These aircraft were lost during World War II-era carrier qualification training. A Douglas SBD Dauntless dive-bomber and a Grumman F4F Wildcat fighter were first recovered for loan to Patriots Point Museum in Mount Pleasant, South Carolina. Captain Bob Rasmussen, Director of the Navy's

Underwater Archaeology, 1999:46–51.

National Museum of Naval Aviation (NMNA), heard of the recoveries of these two aircraft, of which his museum did not have examples, and realized the lakes and oceans were a "deep freeze" stocked with well-preserved World War II Navy aircraft. He also discovered that these submerged aircraft might be used to trade for aircraft recoveries, restoration services, or as items to trade for other aircraft. U.S. law allowed military museums to exchange one item for another. In 1988, Rasmussen found an advocate in Congressman Earl Hutto, who sponsored legislation permitting military museums to exchange equipment for services, including salvage and restoration. The NMNA used this mechanism to trade the title to two Wildcats and a Dauntless for the services of A&T Recovery. In return, A&T Recovery salvaged a Vought Vindicator, a Dauntless, and a Wildcat for the Museum. Since that time, the Museum has sponsored over two dozen aircraft recoveries from Lake Michigan. The NMNA credits the trading program with supplying half of its collection (Hoffman 1998:39-40). Their trading policies had a downside, encouraging a market for Navy aircraft that resulted in increased salvage interest in Navy aircraft wrecks and fostering a climate of exploitation.

As the NHC became involved in underwater archaeology, it was faced with ensuring that the other Navy commands follow the guidance of the National Historic Preservation Act (NHPA). This was applied to the Lake Michigan and other aircraft recoveries proposed by the Museum. The most significant Navy aircraft to be pulled from Lake Michigan was an SBD-2 Dauntless, a veteran of the Battle of Midway and Pearl Harbor, and clearly National Register eligible (Wills 1997).

A Grumman F6F-5 Hellcat was the first contest the NHC fought over aircraft. It was a battle over ownership, but also over historic preservation. An aircraft wreck was spotted in 1993 on the seabed off Martha's Vineyard, Massachusetts, during a U.S. Coast Guard aerial security patrol. The wreck was investigated and identified as World War II vintage. More research revealed it was an aircraft attached to a Night Air Combat Training Unit headquartered at Charleston, Rhode Island. On 3 April 1945, the aircraft, piloted by Ensign Vincent A. Frankwitz USNR, ditched due to engine failure. Ensign Frankwitz escaped from the sinking aircraft but perished in the 42°F water. Of the 12,275 Hellcats built during World Ware II only 20 are now extant. This specific Hellcat was found to be an early production variant of which only 1,404 were built (Weekly 1994:12).

Quonset Air Museum, a fledgling air museum in Rhode Island, was immediately interested in adding this aircraft to their collection and proceeded with recovery. The initial recovery efforts failed because of lack of removal of sediments. Publicity over these efforts alerted the NHC, which contacted Quonset Air Museum. The Museum requested the loan or donation of the aircraft. In response, the NHC requested a submission of plans for recovery, conservation, and restoration, and warned Quonset that they must first obtain Navy permission before recovery. Damon Ise, the president of Quonset Air Museum, agreed not to proceed further without Navy approval. This promise was soon forgotten, however, and on 5 December 1993, without notifying the Navy, Quonset recovered the Hellcat (Weekly 1994:13-14). Although the recovery was lauded in local press accounts, the Hellcat suffered significant damage from the recovery, losing the tail section, wings, and engine. Most of the portions were eventually recovered, except for the engine, which could not be relocated.

The breach of faith forced the Navy's hand, and the Judge Advocate General (JAG)-Admiralty Division requested the Naval Criminal Investigative Service (NCIS) initiate an investigation. In an effort to deter others from similar salvage attempts, the Navy asked that the aircraft be turned over and transported to the NMNA in Pensacola, Florida, at Quonset's expense. In reality, this course of action was a disadvantage for NMNA, which already had a Hellcat in their collection.

This new acquisition would force the reallocation of scarce resources to pay for the restoration and conservation.

Quonset sued for ownership of the aircraft and eventually spent several thousand dollars on legal fees. The Navy responded by defending government ownership. Both sides took a beating in the newspapers with the Navy portrayed as the schoolyard bully and Quonset as a looter of war graves and taker of federal property. More than a few David and Goliath comparisons were made in the newspapers. Eventually an out-of-court settlement was reached whereby Quonset Air Museum obtained the aircraft on loan, the aircraft remained Navy property, and, would be conserved and restored according to Navy standards. In this agreement, replacement of parts would be minimal and the aircraft would be stabilized and exhibited as an artifact from the seabed.

This was not the only battle over ownership of Navy aircraft. As the Hellcat incident was resolved, two other legal cases were developing. One confrontation occurred over a rare Navy aircraft 20 mi. off the coast of Florida in 500 ft. of water and the other involved an aircraft pulled from the Indiana waters of Lake Michigan. The former was a Douglas TBD Devastator discovered in 1991 by New York-based treasure hunter Robert Cervoni, who first offered to sell the coordinates to the NMNA for $25,000. After the Navy did not immediately purchase the coordinates, Cervoni sold the coordinates for $75,000 to Doug Champlin, a collector of World War II aircraft with a museum in Arizona. Champlin attempted to trade the coordinates to NMNA for one or two Wildcats recovered from Lake Michigan. In early 1994, he hired a submarine to recover a portion of the aircraft's canopy and directed his attorney to arrest the aircraft as abandoned property in a Miami court. Discovering that an Admiralty arrest had been made in federal court, NHC requested JAG-Admiralty Division and the Department of Justice (DOJ)-Civil Division take immediate action. The DOJ, after investigating the merit of the case, threatened civil and criminal sanctions if the Admiralty arrest of the aircraft was not dropped and the canopy immediately turned over to the Navy. The Admiralty suit was dropped and the canopy delivered to NMNA. However, this was far from the end of attempts to gain control of the TBD or receive money or other aircraft in trade from the Navy for recovery or the coordinates (Hoffman 1998:40-43). There would be continued attempts to overturn Navy policies through court cases and Congressional legislation.

As the DOJ was resolving the TBD case, NCIS was pursuing Florida salvor Peter Theophanis for the taking of a Douglas Dauntless SBD aircraft in 1993. Theophanis originally was searching for an aircraft he hoped to sell to the NMNA. Unable to find that aircraft, he offered to recover another Navy aircraft for the Museum but was rejected. Unknown to the Navy, Theophanis later brought up this Navy aircraft from Indiana waters, delivered it on the dock to a middleman buyer, who then resold it to a private collector. The recovery, which took place at night, was discovered by a reporter listening to a marine radio and reported in a local paper. A&T Recovery, a rival salvage firm, informed on Theophanis, and the NMNA requested the NCIS investigate. Theophanis failed to turn over the aircraft as requested; perhaps he no longer knew where it was located. The U.S. Attorney's Office issued a warrant for his arrest on charges of theft of government property. During the trial it was discovered that the identifying bureau number of the aircraft was misidentified and the case was dismissed on this technicality (Hoffman 1998:41).

Shortly after this, a civil court case in Washington State was initiated against a Navy aircraft located on the bottom of Lake Washington. The Washington federal court may have been chosen intentionally for a 1984 court ruling against the Navy. In this earlier case the judge ruled that the Navy had shown evidence of abandoning a specific Curtis Helldiver (*United States of America, v. Jeffrey Kenneth Hummel and Matthew W. Mc.Cauley*, U.S. District Court, Western District of Washington at Seattle, Case No. C84-

1058C). The Helldiver had been stripped, repeatedly burned by the Navy in fire-fighting practice, and finally taken out in Lake Washington by the Navy and sunk. The judge, in his 1984 decision, ruled that Navy abandonment applied only to this specific aircraft and did not apply to any other Navy aircraft in Lake Washington. Regardless of the limitations of this court ruling, Historic Aircraft Preservation Inc., the plaintiff, chose on 24 May 1995 to arrest a Navy Wildcat. In the resulting 1996 decision, the court ruled in favor of the Navy and ordered that the warrant of arrest of the aircraft be vacated. In addition, the court stipulated that the plaintiff was prohibited from conducting salvage operations or any other activities which would interfere with the U.S. ownership interest in the aircraft, and ordered that any pieces of the aircraft be turned over to the Navy (*Historic Aircraft Preservation Inc. v. One Wrecked and Abandoned F4-F-4 Wildcat Fighter Airplane*, U. S. District Court, Western District of Washington At Seattle, Civil No. C95-0795 Z).

The ruling in favor of the Navy may have instigated Doug Champlin, who still maintained his interest in the TBD aircraft, and who is a constituent of Senator John McCain of Arizona, to attempt to obtain the Senator's support for a proposed Navy Warbird Act that would formally abandon all Navy aircraft lost prior to 19 November 1961. The NHC and Navy JAG rebuked this Act as a self-serving attempt to financially benefit a few salvors, collectors, and their attorneys, at the expense of the American public. The Navy's review of the proposed legislation found it to be in conflict with the Federal Property Act, 40 U.S.C. § 512. Not only was the legislation unnecessary, but if passed it would have led to the disturbance of war graves, foster commercial exploitation and the depletion of a finite resource, and harm the public's interest in these historic aircraft. The saga of the TBD continues, for attempts have been renewed in 1998 to place the wreck under Admiralty court arrest.

Navy Policy and Air Force Policy

The Air Force policy differs strikingly from that of the Navy. The Air Force policy is provided in a 1994 Air Force manual (United States Air Force [USF] 1994):

> Aircraft that crashed before 19 November 1961, when a fire destroyed the pertinent Air Force records, and that remain wholly or partially unrecovered are considered formally abandoned. The Air Force neither maintains title to, nor has property interest in, these aircraft. The authority for access to, and recovery of, these aircraft, as well as liability for damages associated with their recovery, are matters to be resolved between persons seeking recovery and landowners of the wreckage sites.

In 1996, the Air Force added the caveat,

> if any human remains are discovered at the site, recovery personnel should immediately contact the nearest United States Embassy or United States military installation. To assist in proper identification of remains, recovery personnel should refrain from further operations at the site pending removal of the remains by United States experts (USF 1996).

Interestingly, the Air Force records claimed to have been lost in a fire can be found elsewhere. According to the web site for the Air Force Historical Research Agency (AFHRA, see http://www.airforcehistory.hq.af.mil/faq/index/html), their agency "maintains individual records for all aircraft once or presently in the United States Air Force inventory. These records begin in 1924 and continue to July 1990 and appear to be about 98 percent complete" (USF 1998). Aircraft salvors have expressed amusement at the Air Force's claim that the records were lost. One career aircraft salvor created his private database from approximately 67,000 individual Army Air Corps and Air Force accident records (Hoffman 1997:29). Perhaps as many as 44,000 of these records represent accidents that resulted in the loss of the aircraft. Potential wreck sites represent possibly half this number. Air Force abandonment was also the basis for attempting to get the Navy to abandon its aircraft in the recently proposed Warbird Act. The Navy has not

disputed the Air Force claim of abandonment, but other agencies have not recognized the Air Force's assertion as legitimate abandonment (Pelkofer 1998).

Value of the Resource

Why the intense interest in Navy aircraft by salvors? Dollars, real and anticipated, are the principal motive. The Hellcat recovered by Quonset Air Museum, although badly damaged, had an estimated value of $200,000. Two Lake Michigan Wildcats recovered by A&T Recovery were reported to have been sold for $250,000 apiece. And the rare TBD off Florida was estimated to have a value of one or two million dollars once restored. Aircraft museums, in the crush to build collections, have been an impetus for recoveries and have been instrumental in creating a market value for historic aircraft. This is a familiar pattern with museums, for it is similar to how the acquisition practices of many fine arts and archaeological museums stimulated looting of archaeological artifacts and illegal collecting of stolen art (Herscher 1998:66-78).

Navy Leadership

The NHC has significantly advanced the cause of historic aircraft preservation since 1993. By undertaking NHPA Section 106 compliance, the NHC has used the same measuring sticks applied to other historic properties. Applying the NHPA to aircraft, however, has not been as straightforward as its application to historic buildings, archaeological sites, and ships. The NHC, because of the ambiguities with aircraft wrecks, sponsored in 1993 the development of a National Register Bulletin, *Guidelines for Evaluating and Documenting Historic Aircraft Properties* (Milbrooke 1998). This recently published bulletin provides guidance for federal agencies in managing historic aviation properties including aircraft and aircraft wrecks. Another ongoing NHC project is an inventory of Navy aircraft wrecks and recommended guidelines for documenting Navy aircraft wrecks.

The Navy maintains ownership of its historic aircraft in order to preserve the nation's heritage in naval aviation. In a letter from the Advisory Council on Historic Preservation, Deputy Executive Director John M. Fowler, commented on Navy policy:

> By continuing to claim ownership we believe that the Navy is in a good position to advance the causes of preservation of those aircraft that are historic, i.e., that meet the criteria for inclusion in the National Register of Historic Places. . . . [W]e believe the Navy's ownership position is consistent with the stated goals of the National Historic Preservation Act (16 U.S.C. 470 as amended). Sections 110(a)(1) and (d) of the Act require that Federal agencies assume responsibility for the preservation of their historic properties, and carry out programs which further the purposes of this Act. By maintaining jurisdiction over their downed aircraft, and by supporting the restoration, education, and display of those historic properties significant to the Navy in particular and the history of aviation in general, the Navy is taking a reasonable and responsible role in the field of aircraft historic preservation (Fowler 1994).

In five years NHC personnel have drafted and established Navy policies and set precedents, assisted in the drafting of a National Register bulletin, successfully applied Section 106 to many aircraft wreck sites, and achieved a number of legal victories in preserving and promoting naval aviation history.

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Wharf, Mining, and Production: A Nineteenth-Century Waterfront Alum Mining Operation

Introduction

On 29 May 1998, the Maryland Maritime Archaeology Program (MMAP) staff received a phone call from Mr. Tom Price. Following instructions from a Department of Housing and Community Development (DHCD) public education flyer, Mr. Price reported what he believed to be the ferry landing at North Ferry Point, Magothy River, Anne Arundel County, Maryland. Staff archaeologists reviewed archaeological records and standing structure files, which indicated no known cultural resources at the reported site. A field check of the area was performed to determine the historical significance of the site on 5 June 1998.

Two parallel walls of stone were immediately observed jutting into the water, perpendicular from the shore. This investigation recorded preliminary site dimensions, observed 19th-century ceramics, bracing timbers, and unexpected finds of slag clumps.

The site visit generated more questions and left staff with no clear understanding of the site's age or cultural significance. This slag would have to have been associated with some type of steam engine or possibly a processing facility for an industry such as iron making. A second search into historic maps of the site indicated that an alum works had been present prior to 1847; this is the first alum works in America and also the first to be studied archaeologically. An intensive investigation of this cultural resource was scheduled for August of 1998.

Historic Background

John Gibson began surveying the land of the alum works as early as 1807 and cleared title for 800 acres in 1812 on Cape Sable, Anne Arundel County. Cape Sable is the patent name for present day North Ferry Point. The original intent was to mine coal on the property. By 1813, agreements had been made with Gerard Troost to begin mining the natural resources of Cape Sable and processing alum, with the newly named Alum and Copperas Company (Elizabeth Hughes 1998, pers. comm.).

Gerard Troost was a Dutch physician who arrived from Europe in 1810 and settled in Philadelphia. Troost's specialties included pharmaceutics and crystallogeny. In Philadelphia, Troost began a pharmacy that failed and then taught at the Philadelphia School of Pharmacy, in addition to being the first president of the Philadelphia Academy of Sciences. In his spare time, Troost recorded natural resources surrounding the city in both New Jersey and Pennsylvania (Halsey 1866:593-640; Merrill 1924:111-112).

Cape Sable's soil matrix consists of *Matawan* formation on top of 21 ft. (6.4 m) of the *Upper Cretaceous Magothy* formation, which is above the *Raritan* formation. Its geological age is between 70 and 80 million years old. This formation consists of pyrite, lignite clay, and 4 ft. (1.22 m) of "black massive earthy lignite, containing pyrite and pyritized wood" (Watson 1961). It is the lower portions that were used in alum production; however, other products, such as sulfuric acid, are possible from these resources.

Alum production required a sizable work force to mine and process, which were labor-intensive activities. The mined clays would be piled in mounds with firewood and ignited. Workers would pick holes in the mound to allow air in and increase the temperature of the fire. Burnt alum ash would be added to water, to enrich the liquid, and then heated in kilns by a boiler. The superheated solution would then be poured in barrels and cooled for approximately 14 days, after which the barrel hoops were removed and staves pulled off to reveal a solid crystal block of alum (Diderot 1987).

Archival inventories for the alum works list all the necessary equipment and labor required for

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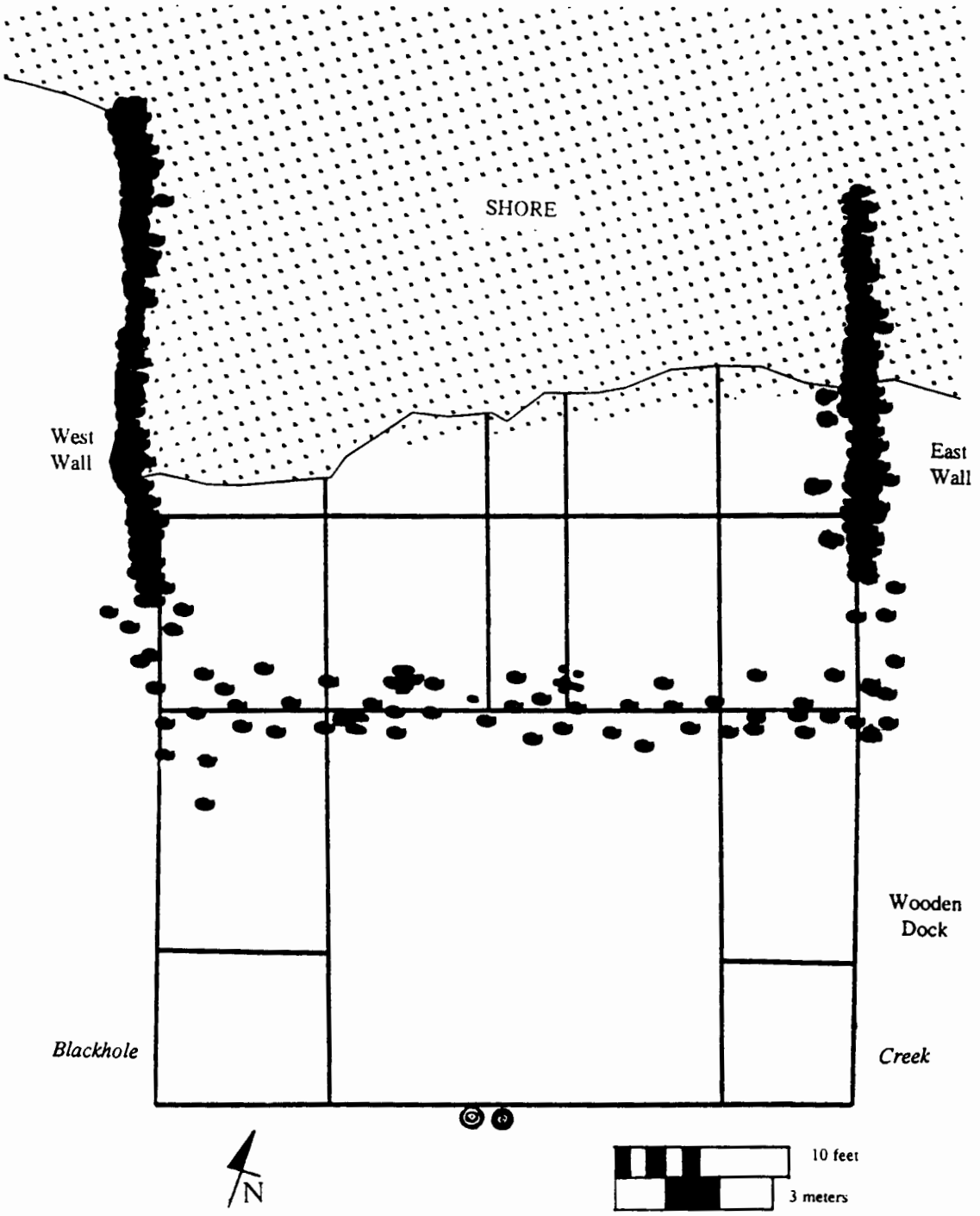

FIGURE 1. Alum Works 18AN1090, preliminary site plan. (Drawing by Paul Impelluso, December 1998.)

FIGURE 2. The three stone walls exposed during a winter blowout. A blowout is a natural phenomenon which tends to occur during the winter months at periods of low tide combined with a northwest wind. (Photo by Robert M. Wilson.)

alum production at the site. These records document 11 boilers, additional steam equipment components, shovels, wheelbarrows, carts, blacksmith tools, carpenter tools, oxen, mules, and horses. The company engaged in full-time operations performing mining and alum production between 1813 and 1820. Final gross sales figures were just over $65,000 and was made up of $59,000 of alum sales, $3,000 of lead, and $2,000 of copperas.

The Alum Works site is an early indication of how Maryland's economy shifted in the 19th century from a primarily agricultural-based society centered around plantation life to an industrial environment. Records indicate that African-American labor served as a major portion of the bought or leased work force. Some of these laborers were skilled craftspersons, with abilities that may have been acquired at their home plantation. Three letters record people leased to the site and reference owner names, the leased person's name, and the cost and length of the lease (Ridgate 1827; Lusby 1828; Maryland State Archives 1828).

1998 Field Work

The goals of the 1998 investigations were to record the submerged wharf structure and locate cultural resources related to mining and process-

FIGURE 3. The wooden dock timbers exposed during a winter blowout. (Photo by Robert M. Wilson.)

ing operations. These were performed with remote sensing, limited site testing, limited artifact recovery, preliminary mapping of the site, and non-systematic upland surface searches.

Prior to site testing, all participants were familiarized with the hand-held water induction dredge and surface-supplied diving procedures. All underwater archaeological work was to take place in water no deeper than 10 ft. (3.0 m). Divers working on the wharf features were equipped with surface supplied air regulators. This method allowed the divers to freely position the dredge head into selected excavation pits and to record submerged features for extended periods of time underwater.

During the five days of excavation, six test areas were selected. Wharf features consisted of a U-shaped stone wharf arrangement with a wooden dock extension (Figure 1). In each test area, sediments were removed and screened into 1/4 in. mesh floating screens. Records were kept of artifacts or significant variations of material in these tests. A comprehensive profile map of the wooden dock extension's eastern timbers was completed.

The U-shaped stone wharf feature was made up of three walls constructed of local ironstone (also called 'Brownstone') which historically was used as a local exterior construction material or for foundations (Harrington 1917:125). Surface features and excavations indicated that these walls were cross-braced with cut cedar trees for additional structural support. East and west walls protruded into the creek and were oriented 6°

west of due north. The walls are 60 ft. (30.5 m) apart at the southeast and southwest intersections with the southern wall. Parallel wall widths varied between 2 and 3 ft. (0.6 to 0.9 m) over the entire length. Both east and west walls connected to the southern submerged and fallen wall 24 ft. (7.3 m) from shore; however, the west wall continued north for 45 ft. (13.7 m) where the eastern wall only continued for 15 ft. (4.6 m) inland (Figure 2). Artifacts recovered within the stone wharf suggest both industrial and non-industrial functions. These artifacts consisted of a wooden stake, leather shoe heel, and stoneware ceramics.

The wharf was extended an additional 22 ft. (6.72 m) by 58 ft. (17.68 m) with a wooden dock structure (Figure 3). This feature was made of local pine trees, most likely the Virginia Pine *(Pinus virginiana)*, which were cross-braced and notched to fit together. To ensure that the logs did not float away, iron nails were driven into the timbers. Although these nail positions were located by a hand-held magnetometer, no clear nailing pattern could be determined. A test excavation on the eastern extension revealed seven courses of timbers ranging from 5.9 to 7.0 in. (15 to 18 cm) with the buried timbers still covered with bark. In this excavation area, wooden chips and shavings were uncovered, indicating adjustments made to complete the dock feature once timbers were in the water. Two wooden artifacts in the excavation test were recovered. These artifacts were of industrial function and not personal items. These consisted of a small wedge and square block, most likely of oak (*Quercus alba*).

The pine timbers of the dock feature provided evidence of construction adjustments to mate all the courses and a puzzling finishing feature: the ends of the timbers were beveled to points which would appear to hinder vessels from docking. Research has yet to locate a similar pattern of construction in this region (Norman 1987). Outside and centered on the southern-most dock timber are two timber pilings which appear to provide additional support and may have been used to keep vessels off the beveled end timbers.

Pairs of divers performed three 45 ft. (13.7 m) underwater rope-guided circle searches. These divers, equipped with SCUBA gear, completed a magnetometer search out from the middle and extreme southern ends of the wooden dock extension. After completing a sweep of the circle, the pair moved down the rope away from that position by 5 ft. (1.5 m) and continued the pattern. The numerous targets registered were identified as modern beer cans. Under one can, however, a clay tobacco pipe bowl was located which appears in the early-19th century's historical record (Hume 1969:303).

Conclusion

The reasons for the ultimate economic failure of the Alum Works site have yet to be unraveled. However, there exists a wealth of archival data surrounding the bankruptcy of the corporation that initiated this early industrial venture.

The investigations of the Alum Works site has just started. All artifacts are presently being analyzed and conserved. Further data about this unique site will come from additional shoreline and upland surveys. A review of the archival records coupled with further surveys of the scars these activities have etched upon the landscape will enrich our understanding of early American industrial activity in Maryland. The labor aspects will shed new light on the movement of Africans from farms or plantation life to industry. This labor-related data alone will benefit future industrial archaeological investigations, as will research into this unique industrial site, the first of its kind in America.

ACKNOWLEDGMENTS

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Lockman families. Volunteer support, including boats and equipment, were provided by the Maryland Historical Trust, Jefferson Patterson Park and Museum, Anne Arundel County, the Maritime Archaeological and Historical Society (MAHS), Underwater Adventure Seekers Scuba Diving Club of Washington, DC. Too many wonderful archaeological enthusiasts from Maryland and Virginia participated to mention individually here, but their assistance is greatly appreciated.

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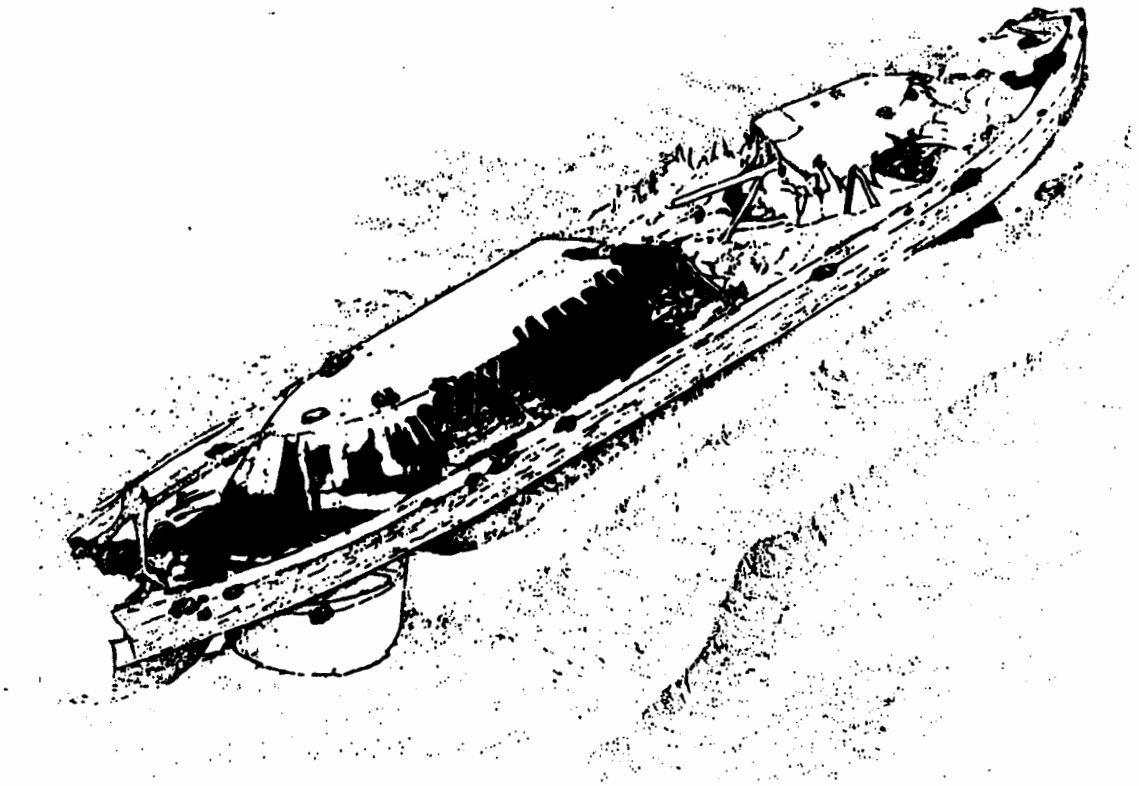

FIGURE 2. The remains of the USS *Monitor* lie 235 feet below the ocean surface with the port side supported above the bottom by the displaced turret. (*Monitor* Collection, NOAA.)

the turret. The inverted hull now rests partially buried in sediment with the stern port quarter supported above the bottom by the displaced turret. The lower hull has collapsed forward of the midships bulkhead, and the stern armor belt and associated structure are 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 (Figure 2).

Comprehensive Long-Range Plan Development

The wreck of the *Monitor* presents NOAA with unique archaeological and engineering challenges that have been made even more complex in recent years by the determination that the wreck is deteriorating at an alarming rate. Since 1990, major changes have been observed in the wreck, apparently due to combination of natural deterioration and human activities at the site. Major expeditions in 1993 and 1995, designed to produce extensive documentation of changes in the wreck as a prerequisite to developing plans to address the crisis, were heavily impacted by severe weather conditions that frequently plague the seas off Cape Hatteras.

In October 1996, in response to the crisis at the *Monitor* Sanctuary, Congress mandated that NOAA develop a comprehensive long-range preservation plan for the wreck of the *Monitor*.

The plan, titled *Charting a New Course for the Monitor*, was submitted to Congress in draft form in late 1997 and, after extensive review by the professional community and the general public, was finalized and submitted in April 1998.

This comprehensive plan describes each major option and planning element in detail and addresses all aspects of management, protection and possible recovery. The plan discusses resources for planning, budgeting, and coordination with governmental and non-governmental agencies with expertise in salvage and marine engineering, conservation, exhibition, and other specialties, many of which must be obtained outside of NOAA's Marine Sanctuaries Division. The plan was developed with the cooperation of the U.S. Navy, Naval Sea Systems Command, and with a preliminary stabilization and recovery plan provided at no cost to the government by Oceaneering Technologies, Upper Marlboro, Maryland, a division of Oceaneering International. In cooperation with The Mariners' Museum, a preliminary conservation and curation plan was also developed.

The comprehensive plan addresses a range of management and research options for the immediate future. The plan includes the following major sections: historical/archaeological research to date, a review of the options for preserving the *Monitor*, the selected option, considerations for making the final selection of options, and final conclusions. The plan recommends hull stabilization combined with selective recovery of major components of the wreck, including the propeller, steam machinery, guns and turret. The plan addresses needs for recovery, conservation, curation, interpretation, and exhibition of the artifacts selected for recovery from the site. The plan calls for six major phases of on-site research and recovery operations: (I) Pre-shoring mapping and archaeology; (II) Shoring beneath the hull; (III) Removal of skeg, propeller, lower hull, and engine; (IV) Removal of armor belt/hull above the turret; (V) Removal of turret and contents; (VI) Post-removal survey and stabilization.

1998 *Monitor* Research Expedition

A large-scale research expedition to the *Monitor* National Marine Sanctuary was conducted during the period 24 May to 25 June 1998. This expedition was the first phase of implementing the recommended option of stabilization and recovery and had as its primary purpose completion of all tasks prerequisite to stabilizing the hull and recovery of major components. The major goals of the expedition were to map and document key areas of the *Monitor*'s hull, to map and recover exposed artifacts, to recover environmental and geotechnical data, and to complete an assessment of self-contained, deep-water diving methodology and equipment. An optional goal, to be pursued if time and sea conditions permitted, was recovery of the *Monitor*'s propeller (part of Phase III). Recovery of the propeller had been a major goal of the 1995 expedition as part of a plan for relieving stress on the stern of the wreck. Adverse weather conditions prevented recovery during that expedition.

The 1998 expedition consisted of two phases: the first was conducted by NOAA and Mobile Diving Salvage Unit Two (MDSU-2), U.S. Navy; and the second was a cooperative effort involving NOAA's National Marine Sanctuary Program, the NOAA Diving Center, the National Undersea Research Center at the University of North Carolina at Wilmington (NURC/UNC-W), the Cambrian Foundation, and The Mariners' Museum. The 1998 expedition was a critical element in the *Monitor* Comprehensive Preservation Plan. The mapping goals (essentially Phase I of the Preservation Plan) were designed to provide the engineering data required for developing detailed plans for stabilization of the hull (Phase II) and for the recovery of key components of the *Monitor*'s hull (Phases III-V).

Diving Methodology

All diving operations during the first phase were conducted from the DSESS *Kellie Chouest*,

a 320-ft. research vessel leased by the U.S. Navy. A U.S. Navy recompression chamber and qualified operators were available on the *Kellie Chouest* at all times. During Phase I, NOAA dives were conducted by a small team of NOAA and Cambrian Foundation divers. The Navy dive team was made up of divers from MDSU-2, Little Creek, Virginia. All Navy dives were conducted using the Mk 21 system, a surface-tended unit consisting of a hard-hat and an umbilical that supplies helium-oxygen breathing gas, hard-wire communications, and hot water that is circulated through a neoprene suit to prevent hypothermia. NOAA dives were conducted completely independently of the Navy dives; however, dive schedules and work tasks were coordinated in order to maximize effectiveness. Unlike the Navy system, NOAA divers were completely self-contained and untethered, a technique that offers high mobility and low cost. All NOAA dives followed procedures and protocols established by NOAA, NURC and the Cambrian Foundation, and approved by the NOAA Diving Safety Board. The NOAA procedures were based on techniques for self-contained, mixed-gas diving developed by the private sector and commonly referred to as technical diving. However, NOAA added significant new safety requirements in order to compensate for the lack of a surface tether. All diving operations in Phase II were conducted by a large NOAA team from the NURC vessel R/V *Cape Fear*, with a recompression chamber and qualified operators aboard the NOAA Ship *Ferrel*. NOAA dive methodology consisted of untethered divers equipped with high-performance scuba equipment, full redundancy and three separate breathing gasses: NOAA Trimix I (18% Oxygen, 50% Helium, 32% Nitrogen) for the bottom gas, NOAA Nitrox II (EANx 36%) for an intermediate decompression gas and pure Oxygen for final decompression.

Archaeological and Engineering Methodology

Archaeological methodology consisted primarily of observation, survey, measurements, and still and video photography. Survey and mapping activities utilized simple techniques, including the use of fixed hull reference points and surveyors' tapes. Probing and limited excavation were utilized for collecting data on the condition and contents of the stern debris field, the northeast deposit area, the area beneath the raised hull and the turret. Engineering methodology included hull measurements and observations, core sediment extraction and soil compaction testing.

Results

The major goals for the 1998 *Monitor* research expedition were met, including measurements and other data identified as prerequisite for stabilizing the wreck. The expedition conducted dives on 27 of 30 possible dive days. A total of 90 dives were conducted, 55 by the U.S. Navy and 35 by the combined NOAA team. The expedition logged a total of 106 hours cumulative bottom time, nearly twice the total (55 hours) of all five previous NOAA diving expeditions to the *Monitor*. Counting the lengthy decompression, the expedition logged a cumulative dive time of 625 hours. Although extensive planning and preparation contributed to this outstanding record, extremely favorable environmental conditions were responsible in part for the successes of the expedition.

Navy divers recovered several deck and hull plates, along with a variety of metal, wood, coal and soil samples. On 5 June, the *Monitor*'s iron four-bladed propeller was successfully raised, along with an 11-ft. section of shaft. On 10 June the propeller assembly was transported aboard the salvage vessel *Kellie Chouest* to Newport News Shipbuilding, where it was off-loaded onto a truck and transported to The Mariners' Museum, Newport News, Virginia. The propeller assembly, hull plates and other artifacts are currently undergoing conservation, a process that is expected to take three to five years to complete for the larger objects. For that reason the Museum made the conservation tanks accessible to visitors who can observe the objects in treatment.

Conclusions and Future Plans

The 1998 *Monitor* Expedition was NOAA's most successful and productive site operation, providing the necessary data for planning the next critical phase of the Preservation Plan, that of stabilizing the *Monitor*'s hull. Using the 1998 data, ocean engineers will develop a detailed plan for shoring up the wreck by placing strong bags beneath the unsupported hull and pumping cement into them. If funding and support can be obtained, the hull stabilization phase will be completed in 1999.

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Channel Islands National Marine Sanctuary: Presenting The Past Through Cooperative Interpretation

Regional History

Channel Islands submerged and terrestrial sites provide present-day man with a window into past cultures. Discoveries made at the islands include the remains of perhaps the earliest island inhabitants dating back over 10,000 years before present (B.P.) and the recent discovery of the most complete prehistoric pigmy mammoth recorded to date. Historically the islands were a special place to the Native Americans known as the Chumash, who traveled to the islands in plank canoes called *tomols* (Terrell 1995:46). These well-traveled waters span European exploration from the 1500s to modern times, challenging the most skilled of seafarers. Due to prevailing currents and weather conditions combined with natural hazards, there are a significant number of shipwrecks.

Channel Islands National Marine Sanctuary

Of the eight Channel Islands in the Southern California Bite, five islands have been designated a National Marine Sanctuary and given National Park status. The submerged cultural and historical resources of the islands, which include Santa Barbara, Anacapa, Santa Cruz, Santa Rosa, and San Miguel, are under the stewardship of the Channel Islands National Marine Sanctuary, Channel Islands National Park, and the State of California. The Marine Sanctuary's jurisdiction, being the greatest, extends from mean high tide to 6 nautical miles offshore surrounding each of the islands, for a total area of 1,252 square-nautical-miles.

The Channel Islands National Marine Sanctuary is responsible for the protection and preservation of submerged remains of the past that occupy the bottom lands of the Sanctuary. Cultural and historical submerged sites include archaeological remains of shipwrecks and prehistoric land sites. Sanctuary stewardship responsibilities include a mandate to inventory sites, encourage research, provide public education, and oversee responsible visitor use.

Site History

Through the commendable efforts led by Don Morris, Channel Islands National Park Archaeologist, and co-author James Lima, an inventory of over 140 documented ship and aircraft casualties occurring from 1853 through 1980 have been published in the *Channel Islands National Park and Channel Islands National Marine Sanctuary Submerged Cultural Resources Assessment* (Morris and Lima 1996). To date, 20 sites have been located, with detailed underwater maps recording four of the prominent submerged shipwrecks.

Channel Islands shipwrecks represent remarkable changes in marine technology in sail and steam propulsion. Two shipwrecks illustrate the evolution of steam-propelled engines. Both were steamers owned by the Pacific Mail Steamship Company, employed in the Pacific coastwise passenger and cargo trade, and are wrecked in the Sanctuary and Park. They include the California gold rush side-wheel steamer *Winfield Scott*, a product of the New York shipyard Westervelt and Mackay, built in 1850, and the steamer *Cuba*, built in 1897 at the shipyard of Blohm and Voss in Hamburg, Germany. The advent of modern steam propulsion is represented by the *Cuba*'s two Blohm and Voss triple-expansion engines driving two propellers, whereas the *Winfield Scott* built only 47 years earlier, was powered by two Morgan Iron Works side-lever steam engines driving two paddle-wheels. Other contrasts between these two steamers include changes in hull design and types of material used

Underwater Archaeology, 1999:64–70.

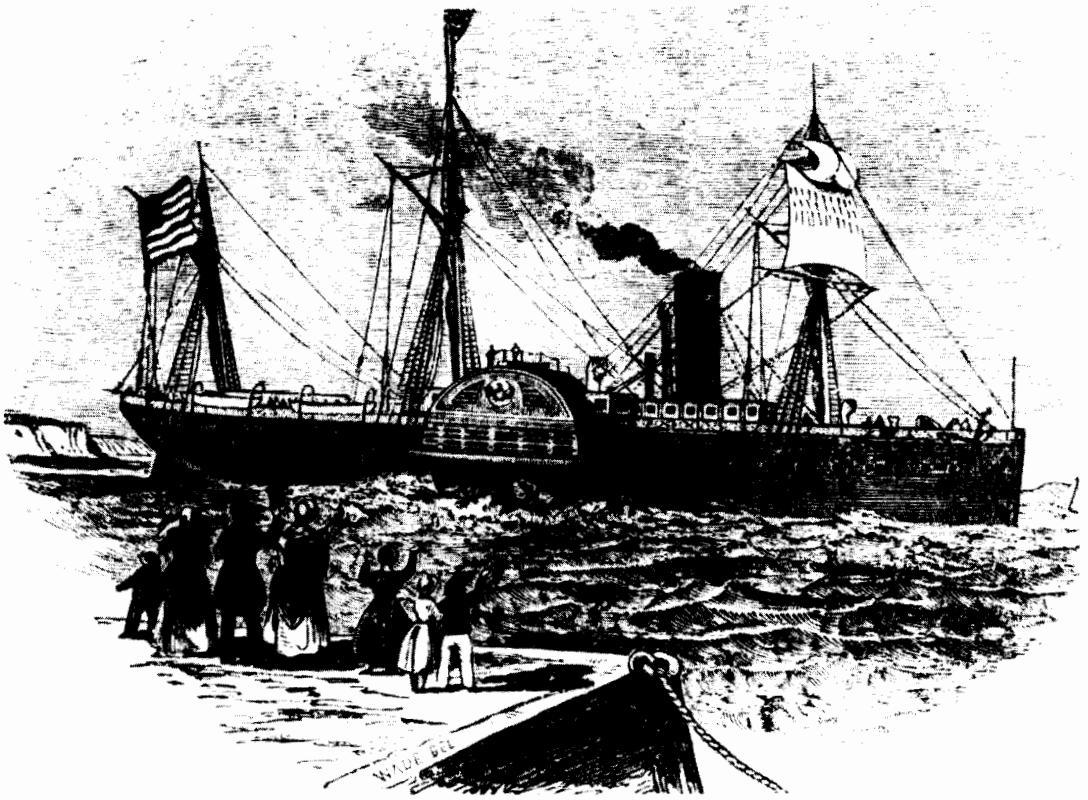

FIGURE 1. A contemporary illustration showing the California gold rush passenger steamer *Winfield Scott* as it appeared on its maiden voyage. The steamer was launched 22 October 1850 at the shipyard of Westervelt and Mackay.

in their construction. The beamy *Winfield Scott* was built of oak, locust, cedar, and Georgia yellow pine as compared to the steel-hulled *Cuba,* with an outer profile similar to the modern day freighter (Kemble 1972:252).

Winfield Scott

Winfield Scott was launched in New York on 22 October 1850. Officially registered with the following dimensions: gross tonnage 1,291, length 225 ft., breadth 34 ft. 8 in., and depth of hold 29 ft. 2 in. (Figure 1), the wooden hull was reinforced with double iron bracing. Mounted at the vessel's stem was the bust of General Winfield Scott for which the vessel was named. The steamer had three decks with accommodations for 165 cabin and 150 steerage passengers (Kemble 1972:252). Upon arriving at San Francisco on 28 April 1852, the steamer was assigned the San Francisco, California, to Panama route, ferrying passengers and cargo along the Pacific Coast (Delgado 1990:60-61). On 2 December 1853, while enroute from San Francisco to Panama with over 300 passengers on board, the *Winfield Scott* became stranded on Anacapa Island while attempting to navigate in fog through the Santa Barbara Channel. The passengers and

crew set up a temporary shelter on the remote island until being rescued by the steamer *California* eight days later.

Although the site of the *Winfield Scott* witnessed commercial salvaging since the loss and as late as World War II, many components of the steamer's propulsion machinery still exist today in 25 ft. of water (Figure 2). The larger artifacts include one of the paddle-wheel shafts, paddle shaft support, and two crossheads. A section of hull planks and frames still sheathed in copper with brass drifts is exposed at the site

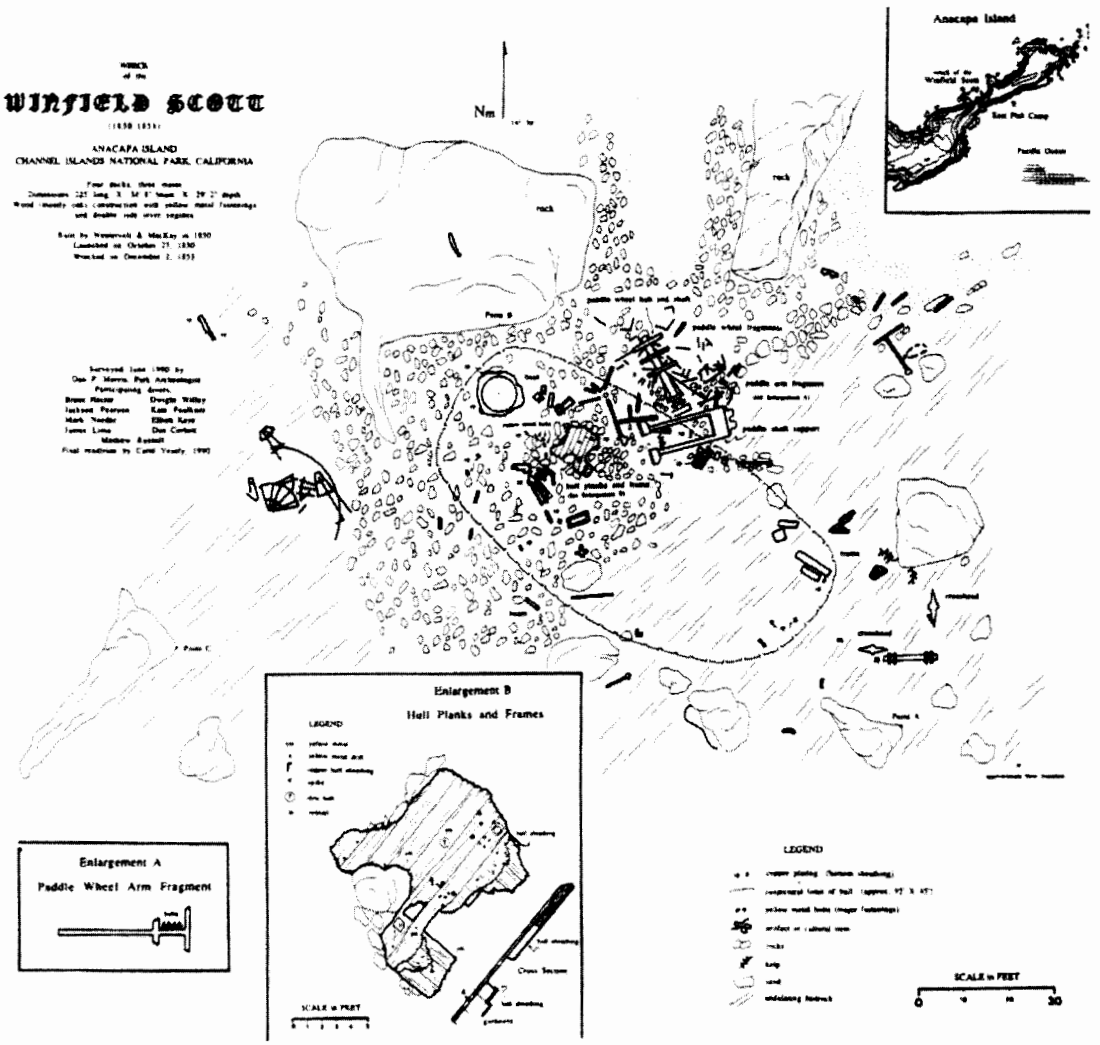

FIGURE 2. Underwater site map of the passenger side-wheel steamer *Winfield Scott* located at Anacapa Island off Santa Barbara, California. Several large components of the steamer's propulsion machinery such as a paddle-wheel shaft, paddle shaft support, and crossheads are still present at the site.

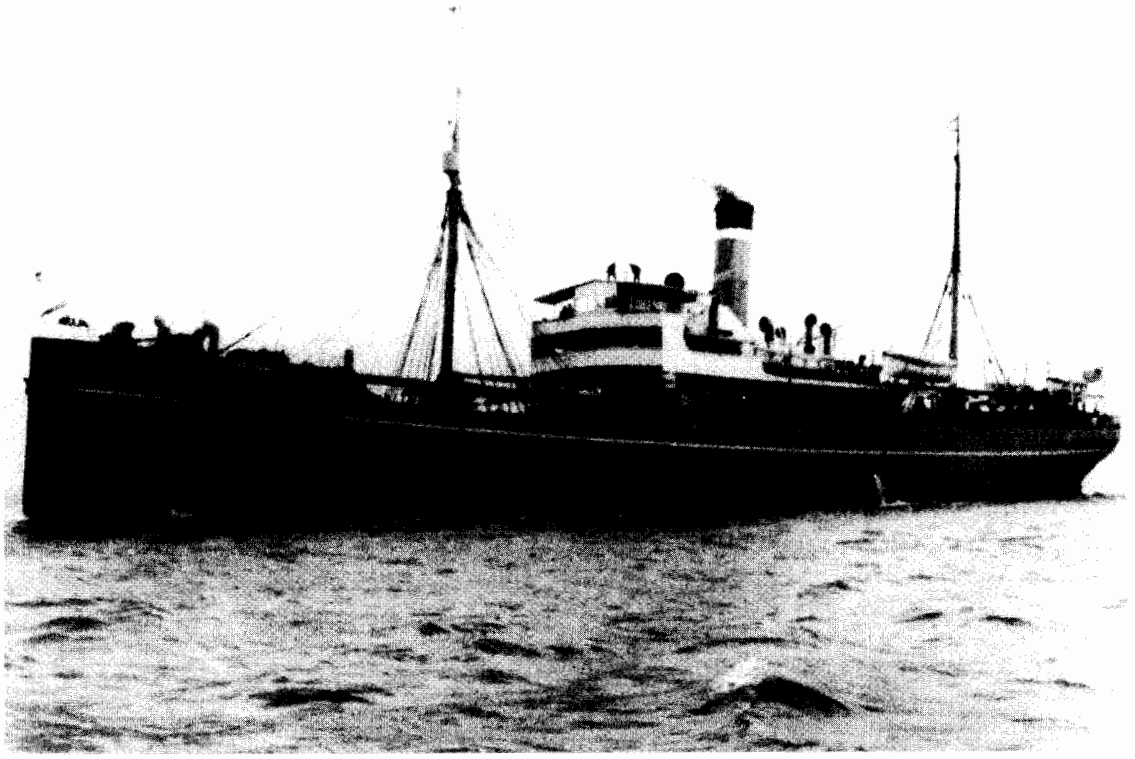

FIGURE 3. A port view of the American vessel *Sachem*, formerly the German steamer *Coblenz*. When purchased by the Pacific Mail Steamship Company the name was changed to *Cuba* and the steamer retained this name until lost at San Miguel Island, off Santa Barbara, California.

(Morris and Lima 1996:20-24). The *Winfield Scott* is listed on the National Register of Historic Places.

Cuba

Cuba was launched in 1897 as the German-registered steamer *Coblenz*. The United States seized the vessel as a war prize during World War I, later changing it to American registry and renaming it *Sachem*. In 1920, the passenger cargo vessel received the name *Cuba* after being purchased by the Pacific Mail Steamship Company (Schwemmer and Gamble 1999). The steel-hulled vessel was officially registered with the following dimensions: gross tonnage 3,168, length 307.7 ft., breadth 42.2 ft., and depth of hold 24.7 ft. (Figure 3). While in service on the San Francisco-Mexico-South America route, the *Cuba* was north-bound for San Francisco when it encountered fog. On 8 September 1923, the steamer entered the Santa Barbara Channel still shrouded in fog in the early morning darkness. Shortly after 4:00 a.m., the *Cuba* struck the outer reefs of Point Bennett, San Miguel Island.

The submerged wreckage of the *Cuba* is the most complete and organized of all the major shipwreck sites in the Sanctuary and Park, resting in 25 ft. of water (Figure 4). The massive Blohm and Voss triple expansion engines rise 14

ft. upright from the seafloor to within 10 ft. of the surface, still positioned behind two single-end Scotch boilers. The site includes fragments of the hull, bulkheads, decking, deck machinery, anchors, and tile flooring (Morris and Lima 1996:55-61).

Goldenhorn

The four-masted bark *Goldenhorn* was built for J. R. de Wolf and Son by Russell and Company of Greenock, Scotland in 1883. Originally ship-rigged, the iron-hulled vessel was officially registered with the following dimensions: gross tonnage 1,914, length 268.6 ft., breadth 40.2 ft., and depth of hold 23.7 ft. On the evening of 12 September 1892 the *Goldenhorn* was enroute from Newcastle, New South Wales, Australia, to San Pedro, California, with a coal cargo destined for the Southern Pacific Railroad Company. Encountering thick fog off Santa Rosa Island, the bark was becalmed and driven ashore by a strong current and swell at 8:00 in the evening (Schwemmer and Gamble 1999).

The shipwreck scatter of the *Goldenhorn* lies in 30-40 ft. of water off the southwest coast of Santa Rosa Island. The mapping of this site was started in 1985, identifying three separate scatters of wreckage, including an 83 ft. section of bottom hull. Additional material has been located along the nearby shore, including hatch covers and a stockpile of coal on the coastal terrace salvaged by Chinese-American abalone fisherman (Morris and Lima 1996:32-37).

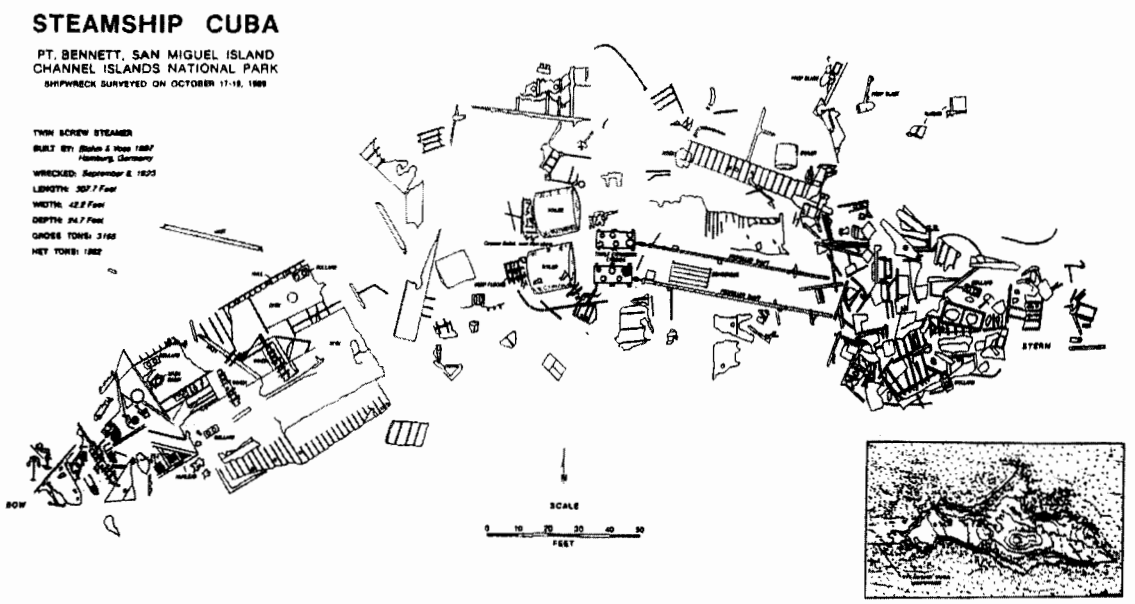

FIGURE 4. Underwater site map of the *Cuba*, the most complete and organized of all the major shipwreck sites discovered in the Channel Islands National Marine Sanctuary and National Park. The massive Blohm and Voss triple expansion engines rise 14 ft. upright from the sea floor to within 10 ft. of the surface.

Aggi

The three-masted full rigged ship *Aggi* was built in 1894 at Glasgow, Scotland, by Mackie and Thomson. Originally christened with the name *Seerose*, later changing to *Sant' Erasmo*, and then renamed *Apise*, the *Aggi* was owned by the Norwegian firm of B. A. Olsen and Son. The steel-hulled vessel, having similar dimensions to the *Goldenhorn*, was officially registered with the following dimensions: gross tonnage 1,898, length 265.0 ft., breadth 39.1 ft., and depth of hold 23.1 ft. With a cargo of barley and beans, the *Aggi* departed San Francisco, California, on 29 April 1915 under tow by the steamer *Edgar H. Vance*. Enroute for the Panama Canal to later sail on to Malmo, Sweden, the two vessels encountered a severe storm causing the hawser to part. The steamer limped back to San Francisco leaving the *Aggi* to survive on its own. The cargo shifted, putting the lee rails under water and submerging half the bunks in the forecastle. Although an effort was made to reach Santa Barbara, the vessel was unmanageable and struck Talcott Shoals, Santa Rosa Island (Schwemmer and Gamble 1999).

The shipwreck remains of the *Aggi* lie at the top of the shoal in 14 ft. of water and scatter down the shoal to a depth of 55 ft. The site is more scattered than that of any of the other major shipwreck sites in the Sanctuary and Park. At the top of the shoal is a large piece that makes up most of the hull bottom, containing the keelson and side keelsons. Fragments of masts and other portions of rigging are scattered over the entire site, with new sections discovered during the 1997 underwater mapping project. Several larger artifacts have been recorded, including anchors with chain, a capstan, steering gear, steel knees, and a donkey boiler (Morris and Lima 1996:48-50).

Partnerships

The archaeological and archival studies being performed to inventory, locate, record, and monitor cultural and historic resources in the Sanctuary and Park are supported by unique partnerships. Faced with level funding, the Sanctuary seeks to establish partnerships with other government agencies and local community groups to implement cultural resource programs. The Sanctuary and Park utilize the resources of each agency to provide support for year-round dive operations that include mapping and monitoring of submerged sites. A key element to the success of these programs is linked through the partnership of the community-based group Coastal Maritime Archaeology Resources (CMAR), an affiliate of the Los Angeles Maritime Museum. This non-profit organization provides a wealth of expertise in archival research, submerged site mapping, videotape recording, monitoring, and final production of site reports. Many of the shipwreck reconnaissance projects at the Channel Islands include divers representing the Sanctuary, Park, CMAR, Minerals Management Service (MMS), and Submerged Cultural Resources Unit (SCRU) working underwater side by side.

An important goal of the Sanctuary program is to engage public awareness through exciting interpretation programs addressing the important resources located in the Sanctuary and Park. The Channel Islands National Marine Sanctuary and Santa Barbara Maritime Museum have joined in partnership to provide the public with an exceptional program featuring the shipwrecks and archaeological work being performed. Five interactive exhibits will highlight the rich maritime heritage of this region. The first exhibit is a diorama of the *Winfield Scott*'s survivors camp presenting first person diary accounts of the vessel's stranding and the survival of the passengers and crew on the remote island of Anacapa. The second exhibit is a diorama of the present-day submerged site of the *Winfield Scott* and provides the public with an educational experience, explaining the archaeological studies being performed at this site. The third exhibit also includes a diorama featuring the *Cuba* and encompasses a cutaway model to correlate submerged artifacts to their original use aboard ship.

The fourth exhibit will describe in detail 12 individual shipwrecks involved in different maritime trades, trade routes, and their historical significance to the region. These exhibits will be accompanied by information about the cultural resources management programs of the National Marine Sanctuary Program, National Park Service, and State of California. The fifth exhibit will feature a virtual full motion submersible simulator that will take 12 passengers on an inner-space voyage through the Santa Barbara Channel to visit the Sanctuary and Park. The sensation of undersea flight motion will take the public along the dramatic underwater escarpment, with a variety of exciting underwater encounters, ultimately arriving at the shipwreck site of the *Cuba*. Underwater archaeologists will be viewed recording the site while establishing communications with the submersible, to engage the public's awareness of the important work being performed at the Channel Islands National Marine Sanctuary and National Park.

ACKNOWLEDGMENTS

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Beacons of the Florida Keys as Submerged Cultural Resources

Introduction

Aids to navigation, particularly lighthouses and beacons, have a certain fascination, seeming to have stood alone at sea for eternity. The historic documents summarized below dispel this romantic notion. The system of government-erected beacons marking the reefs of the Florida Keys began in 1837 (Whitehead 1837). It was years in the making, required constant maintenance, and often included replacement as diligent efforts were made to improve safety in navigating this hazardous area. An understanding of the history and archaeology of navigational aids in the Florida Keys can provide a new perspective for interpreting our maritime culture.

History

F. H. Gerdes, an Assistant Superintendent in the U.S. Coast Survey, reported that 174 vessels had wrecked on the Florida reefs during the period from 1844 to 1848. The value of the vessels and cargo was almost $6 million. Stephen R. Mallory, the collector of customs in Key West, wrote a letter in 1848 to Alexander Dallas Bache, the Superintendent of the Coast Survey, summarizing his feelings about the state of navigation in the area:

> let the channels through Florida reefs be examined and buoyed throughout, and let the coast be marked with but half the number of good lights which designate the same extent of our northeastern seaboard, and, while the benefits conferred upon our country in a military point of view will be invaluable, the number of shipwrecks on that coast will be reduced to the few that may result from violent hurricanes or other overwhelming calamity (Bache 1848:11).

At this time there were only three lighthouses from Cape Florida to the Dry Tortugas. He went on to say that forts were under construction at Key West and Tortugas and how strategically important these locations were for trade and defense (Bache 1848:11). Mallory wrote, "upon this great highway of commerce, where the property of every section of our Union is afloat, the object of those familiar with the peculiar perils which beset it should be not only to make the route thoroughly safe, but to remove every excuse for shipwrecks" (Bache 1848:12). The following year, Bache (1849:2, 6) pointed out that the current charts were unsuitable for navigation and Gerdes began a reconnaissance from Key Biscayne to the Dry Tortugas.

In the *Report of the Superintendent of the Coast Survey* of 1850, the lightship *Florida* was reported to be on station at Carysfort Reef. The *Florida* was preceded by the lightship *Caesar,* which first took station on Carysfort in 1826. The hull rotted out and the *Florida* replaced the ship in 1831. This reef was considered very treacherous as five vessels wrecked there between 1844 and 1848 (Bache 1850:90).

The lighthouses on Sand Key and Key West were destroyed in the hurricane of 1846 and replaced by a lightship. The lightship was referred to as an astronomical station (Bache 1850:110), perhaps referring to its use for weather and tide monitoring. In 1852, a Lt. Totten reported on the installation of the first screw pile beacons located in 2 to 4 ft. of water on American Shoal, (east) Washerwoman, and Caesars Creek (Bache 1852:97-98). These beacons had been proposed for Collin's Patches (Coffins Patch), Sombrero Key, and Tennessee Reef, but these locations were deemed too deep for their installation. Totten suggested that it might be possible to put a beacon on Sombrero in the future by using a tripod support (Bache 1852:97).

The 9-ft. long, 9-in. diameter screw pile was driven into the bottom and a 30 to 40-ft. mangrove pole was inserted. A black-painted barrel

Underwater Archaeology, 1999:71–79.

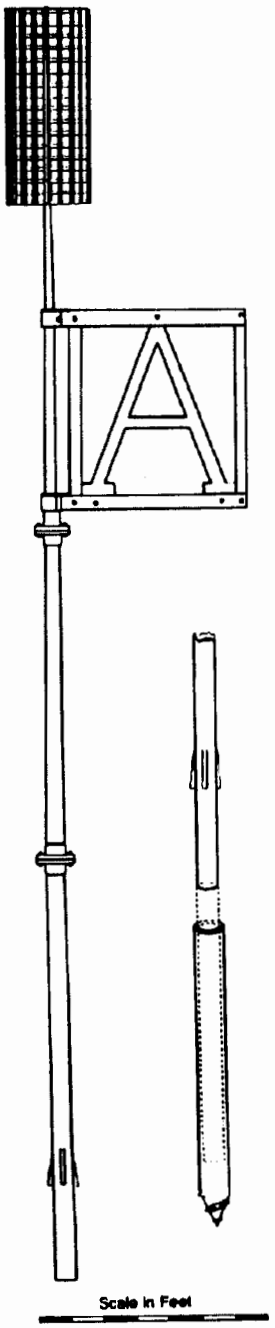

FIGURE 1. Plan for Beacons devised by Lt. Totten. (USCS 1855.)

was placed on top of each pole. Totten states, "as to the screw-piles ever being removed by the violence of the storms, as long as the reef itself whereon they are located remains, I must say that such a thing looks to me extremely improbable. . ." (Bache 1852:98). He reported that the mangrove beacons could be seen for 2 to 3 mi. and with a spyglass for 6 to 10 mi. (Bache 1852:98).

In 1853, plans were implemented to make the beacons more permanent. The new version was constructed with an iron shaft in a screw pile (Bache 1853:174). These beacons had an overall length of 36 ft. and were fixed in a screw pile (Figure 1). The shaft was in three sections. The two lower sections were cast iron while the upper section was wrought iron. The lowest section was 14 ft. long with a collar on the upper end that was bolted to a collar on the base of the mid-section. Likewise, the top of the mid-section was bolted to the base of the top section. The mid-section was 10 ft. long, and the top or spindle portion was 16 ft. (Bache 1856:157). The diameter of the shaft tapered from 7.25 in. at the base to 2 in. at the top. A latticework cylinder of hoop iron, 6 ft. high and 2.5 ft. in diameter, was mounted at the top of the shaft. Each beacon was distinguished by a 6-ft. wrought iron vane in the form of a letter that would move in the wind. Black, red, and white paint in various patterns was used to further aid in identifying each beacon. This series of beacons was labeled from west to east beginning with Eastern Sambo designated as Beacon A (Bache 1856:157-158) (Figure 2). By 1855, 14 beacons had been erected, all signified by a letter and a particular color pattern (U.S. Coast Survey [USCS] 1855:8).

The *Report of the Light-House Board* in 1873 states that beacon series (labeled A through P) was augmented by a second series, put at different locations, and distinguished by numbers 1 through 8. The report states, "the line of iron day-beacons on the shoalier portion of the great Florida Reef, and marking out its general outline along the Gulf, has been completed during the

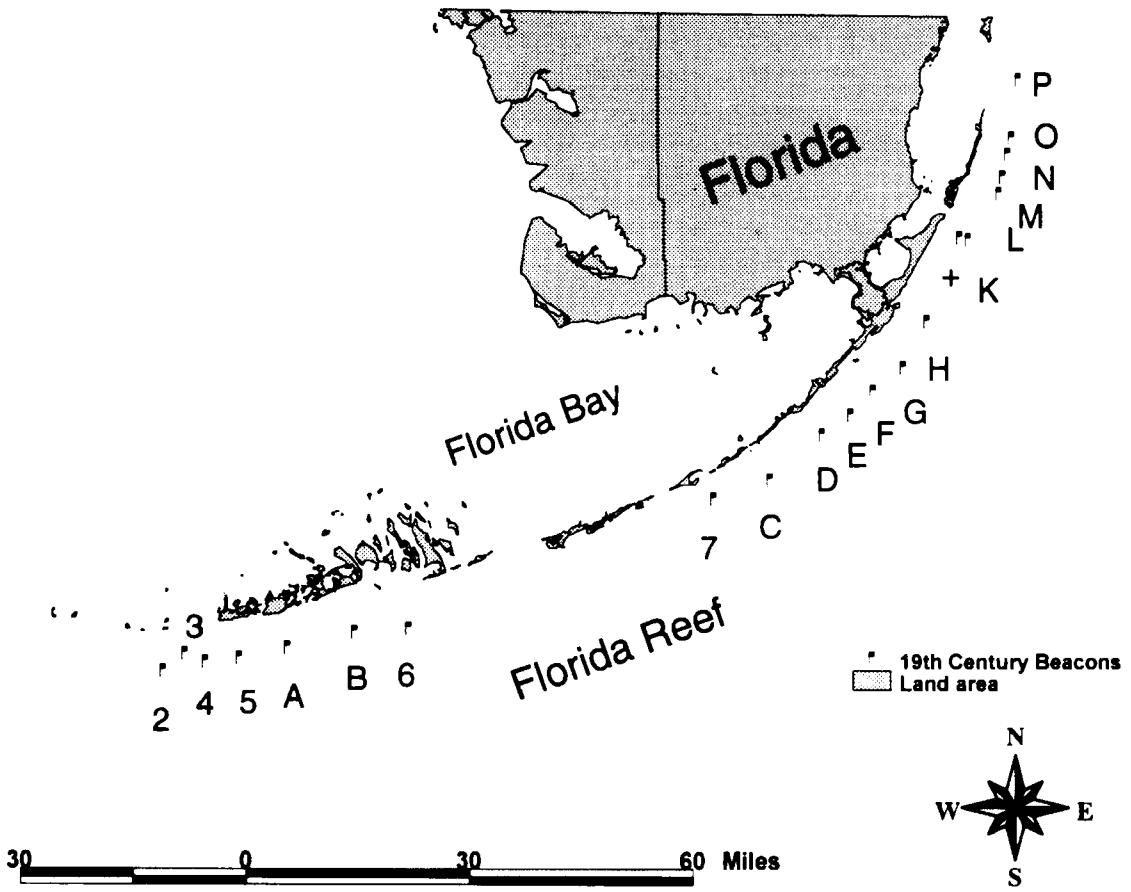

FIGURE 2. 19th-Century Beacons of the Florida Keys. (USCS 1855.)

year by the erection of 13 beacons" (Department of Commerce [DOC] 1873:60). The stations at Carysfort, Dry Bank, Sand Key, Loggerhead, and the Northwest Passage were reported as in need of repairs (DOC 1873:60).

By 1874 there were 17 lighthouses and lighted beacons, 60 unlighted or day beacons, and additional fog signals and buoys in this district, from Cape Florida to Dry Tortugas. Lightships were no longer in use. The lighthouse on Alligator Reef was completed the previous year, and an appropriation of $100,000 was granted to construct a lighthouse on Fowey Rocks that would permit the light at Cape Florida to be discontinued. At this time, the beacons on Carysfort, Sombrero, and the Northwest Passage were singled out for repair. Money had been appropriated for the work, and a new lightkeeper's house was planned on the light at Sand Key. The report also requested $100,000 for a lighthouse at Looe Key stating, "the navigation of this portion of the Gulf is always dangerous, particularly to vessels bound to southward and westward, because of the strong and variable current near the reef, causing many wrecks and much loss of property" (DOC 1874:57).

The same concerns about Carysfort Reef and Sombrero Reef were voiced again 1875. New items stated that land had been reserved for a lighthouse on Soldier Key and funds estimated at $75,000 were needed to repair the light at Loggerhead, Dry Tortugas (DOC 1875:54). The beacon on Rebecca Shoal had not yet been replaced and proposed that a "substantial structure" be built there instead of a beacon. Maintenance was completed on 22 beacons that were reported to have been scraped and painted with two coats in their particular color pattern and that "the remaining beacons of the district are chiefly made of wooden piles and stakes, forming ranges and marking turning-points in intricate channels" (DOC 1875:56). In 1877, estimates were submitted for construction of lighthouses on American Shoal and Rebecca Shoal (DOC 1877:2).

In 1921, the beacons were deemed insufficient for withstanding hurricanes. Twelve beacons were reported lost and others damaged in a hurricane on 9 and 10 September 1919. The report states: "the type of structure for beacons marking the Florida Reefs was established many years ago and does not satisfactorily meet existing requirements. These beacons are usually destroyed by every hurricane that passes over them" (Commissioner of Lighthouses 1921:89). The *Buoy List* for 1923 indicates that beacons on Coffins Patch (probably Beacon C), Maryland Shoal (Beacon S), Eastern Sambo (Beacon A), Western Sambo (Beacon R), and Looe Key (Beacon 6), all with white iron spindles, were included in the losses (U.S. Department of Commerce Lighthouse Service [USDOCLS] 1923). The *Buoy List* of 1926 indicates that all of these were re-established (USDOCLS 1926).

TABLE 1
HISTORICAL OUTLINE OF BEACONS

Beacon	General Location	Source
M	Ajax Reef	Bache 1856
C	Alligator Reef	Bache 1856/1853
B	American Shoal	Bache 1856
G	Big Pine Shoal	USDOT 1978/1979
E	Conch Reef	Bache 1856/1853
D	Crocker's Reef	Bache 1856/1853
5	East Channel Shoal	USC&GS 1878
4	Eastern Dry Rocks	USC&GS 1878
A/M	Eastern Sambo	Bache 1856/ USDOT 1978
P	Fowey Rocks	Bache 1856
G	French Reef	Bache 1856/1853
H/K	Grecian Shoal	Bache 1856/1853
N	Long Reef	Bache 1856
K/H/6	Looe Key	USDOCLS 1932/USDOT 1978/87
L	Maryland Shoal	USDOCLS 1932
3	Middle Ground	USC&GS 1878
L	Pacific Reef	Bache 1856
F	Pickle's Reef	Bache 1856/1853
7	Tennessee Reef	USC&GS 1878
O	Triumph Reef	Bache 1856
+	Turtle Harbor	USC&GS 1878
K	Turtle Reef	Bache 1856
2/K	Western Dry Rocks	USC&GS 1878
N/J/30	Western Sambo	USDOCLS 1932/ USDOT 1978/87

Light Lists reflect changes in many of the beacons (USDOCLS 1937, 1938, 1939; United States Department of Transportation (USDOT) 1978, 1979, 1987). A brief historical outline of the beacons based on these references is provided in Table 1. These references illustrate the changing history of these navigational aids: first established based on need as indicated by vessels and cargo lost; maintained by scraping and painting; and often replaced after a few years of service by a beacon or light at a more strategic location or of more substantial construction. Once they were no longer necessary, they were abandoned. Maintenance was no longer performed and they were no longer included in the official records.

Once the major lighthouses were established, beacons served as supplemental navigational aids. The lighthouses of the Keys have received comprehensive attention in the works of Love Dean (1982, 1992). Dean (1982:22-111) discusses the 1852 Carysfort Reef Lighthouse, 1827 Sand Key Lighthouse, 1858 Sombrero Key Lighthouse, 1873 Alligator Reef Lighthouse, 1878 Fowey Rocks Lighthouse, and the 1880 American Shoal. Dean's next publication (1992:22-71, 112-123, 179-190) was expanded to include the 1825 Cape Florida Lighthouse, 1826 Key West Lighthouse, 1826 Garden Key Lighthouse, 1858 Loggerhead Lighthouse, 1855 Northwest Passage Lighthouse, and the 1886 Rebecca Shoal Lighthouse. Figure 3 shows the location and date of establishment for each lighthouse.

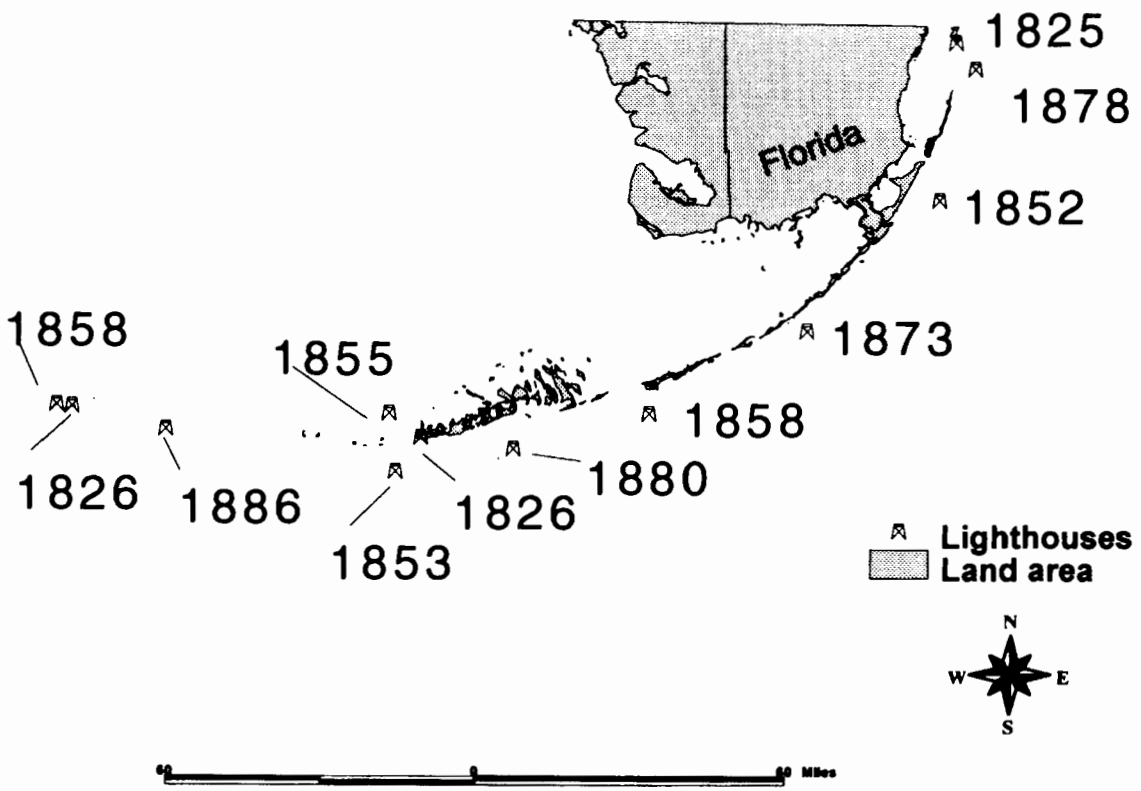

FIGURE 3. Lighthouse location and date of establishment.

Defunct Beacons as Historic Cultural Resources

Looe Key National Marine Sanctuary personnel discovered a defunct beacon on Looe Key that had been impacted by the grounding of the motor vessel *London Lady* in 1988. Investigations determined that it was probably Beacon 6, first established in 1873 and probably destroyed in the hurricane of 1919 (MacLaughlin 1988). In March 1997, the grounding of the containership *Houston* on Maryland Shoal again brought attention to defunct beacons as submerged cultural resources. Submerged Cultural Resources Assessment Project (SCRAP) divers, while assessing the impact to submerged cultural resources, located three defunct beacons on the inshore side of the shoal. Two of these were on the west end of the shoal. One had marked the east end (Whall 1997).

SCRAP began to acquire historical documentation on navigational aids from local historian, John Viele; Sanctuary Resource Manager, Lauri McLaughlin; NOAA, Sanctuaries and Reserves Division Archaeologist, Bruce Terrell; and through additional library research. These historical records together with the archaeological remains of beacons have become a focus of research. Recording submerged cultural resources in the lower Keys is under the direction of David Whall. In the upper Keys, Chuck Hayes organizes the submerged resources inventory (SRI). Now both groups are searching for and recording defunct navigational aids. Beacons located to date are summarized below.

Hayes (1997) recorded a number of beacons in the upper Keys that he feels may date to the 1850s. The remains of a beacon (Z-01-FR) on French Reef consist of two pilings that extend above the surface and several pilings on the bottom. One of those on the bottom has portions of an iron letter. It is most likely the letter "G" as Beacon G was reported on French Reef (Bache 1853).

The base of a beacon (Z-01-PK) is located on Pickle's Reef. It is described as having a flanged base that Hayes (1997) feels was undercut by about 2 ft. He reports that only one out of three piles in the immediate vicinity extends above the surface. The description indicates a tripod, like that of Beacon B on American Shoal.

One beacon (Z-01-CN) was recorded on Conch Reef. The base is still in situ but the shaft is bent so that it runs near the bottom. The pole runs through a large disk near its base like a number of other beacons observed. Several pilings nearby may represent prior tripodal support. Scattered rock (B-05) is nearby (Hayes 1997).

Another beacon (Z-01-CR) is lying on the bottom at Crocker Reef. A wreck site with ballast (W-02) is nearby. A standing beacon (Z-01-TU) was recorded on Turtle Shoal that also may have been supported by a tripod. There are several segments on the bottom and two piles that extend above the water surface (Hayes 1997).

SCRAP divers recorded a beacon on Coffins Patch in about 18 ft. of water. As numerous ferrous piles are present it appears to have been a multi-legged structure. Further west, portions of a disarticulated beacon were located on Looe Key. Beacon segments were in a cluster in about 4.5 ft. of water. This beacon appears to have lacked the large disk-shaped flange near the base that is characteristic of many of the older beacons in the region. These remains may represent one of the later beacons, either Beacon K erected in 1926 or Beacon H in 1939.

A standing beacon on American Shoal appears to be the original Beacon B, located just southeast of the lighthouse. Three ferrous piles evenly spaced around the beacon are still visible above the surface. These pilings were used for the attachment of cables to support the beacon.

The three beacons discovered on Maryland Shoal are puzzling, as it is difficult to distinguish their chronological sequence. One of these, located on the west end of the shoal, was an iron beacon with a disk-shaped flange near the base. The base is in situ and the shaft is bent so that it runs near the bottom on a bearing of 315°. It was shown on the charts as a navigational hazard or submerged piling. Complaints about the

beacon as a hazard to navigation were lodged and it appears that an unknown agency or individuals bent it over completely, so that it lies on the bottom. Nearby, is the base of a second beacon that appears to be made of a copper alloy. The remains of a third beacon, located at the east end of the Maryland Shoal, consist of two separated sections. It resembles the iron beacon at the west end. The base is in situ and the shaft is bent along the bottom on a bearing of 300°. The top half of the beacon lies just to the south on a bearing of 315°. It is likely that both of the beacons went down in the same storm event, as their orientation is nearly the same.

The remains of two beacons were noted by marine biologists on Eastern Sambo. The bases are located in about 8 ft. of water, in situ, and are positioned side-by-side. The upright portions lay nearby on the bottom. Associated with this cluster in the wrought iron letter "A" that represents the earliest beacon on Eastern Sambo (Bache 1856).

At least two beacons were recorded by SCRAP divers at Western Sambo. They are situated near the current day marker 30, at the east end of the reef. There is a cluster of three iron segments that represent one or two beacons. The base section is in situ, broken off about 3 ft. above a large, disk-shaped base. The shaft is bent at a 90° angle just above the base. Another section of the beacon post located nearby is nearly 9 ft. long. A third section is the upper end of the beacon and is 26 ft. 8 in. long. Beyond this, there is an intact beacon post that extends just above the surface. There is a sleeve on top with remnants of wood still inside. This beacon may be one of the earliest types installed, as they were screw piles with tall mangrove signal poles.

In surveys around navigational aids it is important that their history be considered and that archaeological deposits be carefully interpreted. Work around a beacon on Looe Key was described by Whitehead (1837):

> . . . I have this day paid the contractor $1,602.40, being for 4006 cubic feet of stone work at 40 cents per foot. The contractor, through a misunderstanding of my directions, or deeming a greater quantity of work necessary, exceeded the limits given to him, I have consequently only paid him for the work directed to be done consisting of a wall around the beacon at the distance of 6 feet [;] two feet thick and five feet high; having an inclined embankment of stone on the outside with a base of seven feet the space between the wall and beacon being filled in with loose stone. . . .

This account does not mention the kind of rock used for this work. It is possible it was Miami oolite like that quarried from Boca Chica to construct the Northwest Channel jetty off Key West in 1899. Key West historian Thomas Hambright (1998, pers. comm.) noted that this oolite jetty quickly eroded and was replaced by granite. If oolite was used for this protective wall around the beacon described above, it is doubtful any deposits would remain. However, if igneous rock was used, the rubble would remain. While other protective walls around beacons in the Florida Keys are unknown, caution must be used in assessing potential ballast piles around navigational aids.

The archaeology of navigational aids may also be useful in other scientific studies. Hayes (1997) noted that the substrate around the base of beacons recorded in the upper Keys was undercut by several feet. This phenomenon was also noted by SCRAP divers in the lower Keys. In addition to the importance of these beacons in the study of maritime history, there is the potential that biologists and geologists may be able to use the archaeological data to look at changes in substrate levels through time.

Summary

As we approach the 21st century, the importance of navigational aids is even greater as the fragile nature of coral reefs and other marine habitats is realized. In addition, awareness of the potential for severe damage to submerged cultural

resources by ship grounding has grown. Vessel groundings over the last few years have led to a re-evaluation of the current state of navigational aids in the Florida Keys. Recent innovations in navigational technology are now available. The local Propeller Club has called for a new system of RACON beacons (*Lower Keys Barometer* 1998). This change would perhaps be equivalent in scope to the automation of lighthouses years ago. NOAA is planning to install the RACON system that operates by transmitting radar signals to ships at a much greater distance than a traditional navigational light. While this new system will be costly, grounding by large ships should be greatly reduced. Most people would agree with Dean when she wrote, "if the lighthouses have to be replaced I will be saddened, but on a dark stormy night at sea what I want more than the romance of history are the best navigational aids possible" (1982:113).

Research on submerged cultural resources within the Florida Keys National Marine Sanctuary has been limited to an assessment of the upper Keys (Halas 1988), work by Sanctuary volunteers, research and mapping of the wrecks that are to become part of the "Shipwreck Trail" conducted by universities and private consultants, and the recovery efforts of salvors. A comprehensive assessment of submerged cultural resources has not been undertaken and as a result few underwater sites are recorded in the Florida State Site Files for the Sanctuary. A productive starting point for such an assessment would be to survey those areas immediately surrounding beacons as many vessels were lost on these reefs and shoals. Such a study would provide a cross-section of cultural resources along the reef track, and could be accomplished by multiple parties under systematic direction.

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The History of Underwater Archaeology at Florida State University: A Retrospective of the Past and a Look to the Future

Marine research as we know it had its genesis at Florida State University (FSU) in the early 1950s with the work of Dr. Sylvia Earle, a well known marine biologist. As an undergraduate she was working with the FSU Marine Laboratory, which at that time was conducting limited diving projects utilizing surface supply gear similar to that used in Florida's sponge diving industry. Dr. Earle was provided with a new device called SCUBA. As she has explained it, her training before making her first dive from the Marine Laboratory's facilities at Alligator Harbor in 1952, involved a few brief comments about assembling her equipment, and an admonition not to hold her breath on ascent.

Stanley J. Olsen, originally of the Florida Geological Survey, later with the FSU Department of Anthropology, began informal investigations of Florida's rivers and sinkholes as early as 1947, using an open helmet system, and later SCUBA. Under his direction FSU students conducted the first systematic investigations within the cave of Wakulla Springs (Olsen 1958, 1959, 1961). Stan Olsen was also responsible for investigation of many other underwater sites in the region.

Dr. Hale G. Smith, chairman of the Anthropology Department, began in the late 1950s and early 1960s to develop an interest in the potentials of underwater archaeology. He obtained diving equipment, learned to use it, and began some informal underwater archaeological investigations. This was at about the same time, and apparently with the same influences, that John Goggin of the University of Florida developed an interest in the field and began investigations (Goggin 1960). Smith hired Dr. Charles H. Fairbanks into the Department as a second archaeologist for the faculty. Fairbanks also developed an interest in the underwater archaeology.

Although most of their work was informal and not well documented, snorkel and SCUBA surveys were conducted in many of the rivers and sink holes in north Florida. A thorough swimmer reconnaissance was made of the Wakulla River from its origin in the springs, to its confluence with the St. Marks River. Substantial portions of the St. Marks were also surveyed. Fairbanks received funding from the U.S. Army Corps of Engineers for investigations of the St. Marks in connection with dredging operations in 1962. Four underwater sites were investigated and archaeological materials recovered (Fairbanks 1964). In 1963, Dr. William Tanner of the Geology Department organized a program to conduct research diving in support of a study of beach dynamics. Dr. Tanner and his staff spent considerable time training students in safe diving techniques. This program was the forerunner of the later Academic Diving Program's activities within the University. Hale Smith began at this time to collaborate with faculty in the Department of Geology, utilizing expertise of both fields to cross date geological events and archaeological sites on the Florida panhandle, and furthering his interest in the potential for underwater research.

Against this background in underwater archaeology, the National Park Service (NPS) developed an interest in establishing a relationship with FSU. In 1968, the NPS's program in underwater archaeology was initiated in the Division of Archeology in Washington, DC (Fischer and Riggs 1968). It quickly became apparent a field base of operations was necessary, and at this same time the NPS received a mandate to locate its research centers in conjunction with universities whenever feasible. In 1970, the late John Griffin and the author, under a directive from NPS Chief Archeologist John Corbett, began discussions with FSU about the potentials for relocating the Southeast Archeological Center (SEAC) on the FSU campus, with consideration particularly of the potential for underwater ar-

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chaeology. In the summer of 1972 that cooperative relationship became a reality. The SEAC moved to Tallahassee from Ocmulgee National Monument in Macon, Georgia. The NPS underwater archaeology program was then transferred from Washington to Tallahassee.

The first major NPS project out of SEAC was undertaken in the summer of 1973, a survey of shipwreck sites at Gulf Islands National Seashore, near Pensacola. Although not formally an FSU project, under the cooperative agreement between the two entities, facilities, equipment, and personnel were pooled (Lenihan 1974; Fischer 1975a). A SEAC archaeologist at the time was Daniel J. Lenihan, then a graduate student at FSU, who has since become Program Manager of the NPS Submerged Cultural Resources Unit (SCRU). A year later Wilburn A. "Sonny" Cockrell, Florida's State Underwater Archaeologist, began teaching the first class in underwater archaeology at FSU. At that same time he also began performance on a contract the NPS had with the State for survey activities at what was then Fort Jefferson National Monument in the Dry Tortugas (Cockrell et al. 1974). Because of extended field commitments through bad weather, the author assisted in teaching portions of the course, the following year began instructing the Underwater Archaeology course, and continued teaching it annually through 1997. At about this same time the Biology Department began formally teaching an interdisciplinary course in scientific diving, which has since evolved into a curriculum of three courses taught under anthropology course numbers through the FSU Marine Laboratory's Academic Diving Program (ADP).

In the early 1970s the University began to develop means of dealing with the burgeoning research activities involving diving. This resulted in establishment of the ADP, headed, then and now, by Gregg Stanton, Director of ADP and University Dive Officer. The ADP's mission was to coordinate training and standards and maintain a university-wide dive locker. It has since evolved and expanded considerably and stands as a leader in the conduct and support of scientific diving. The resources and training opportunities involve a broad range, including mixed gas, rebreathers, dry suits, overhead environments, cold and polluted water operations, chamber operation, and essentially the full gamut of current diving technologies. Stanton and the author quickly found they could work cooperatively quite well to mutual advantage. The basic format of the course was to include student designed and executed research projects. One of the very first student directed projects in 1974 (Prokopetz 1974) returned to the locus of much of the earlier work, in the St. Marks River, off the Spanish fort San Marcos de Apalachee.

The SEAC had responsibilities for, and could provide access to, a number of coastal parks with considerable potential for underwater research. With minimal funding for basic expenses from the NPS, the University could mobilize the underwater research techniques classes to conduct field exercises which provided students with actual underwater research experience and the NPS with useful research data. These projects were mostly brief reconnaissances to assess the potential for underwater research and the nature of underwater resources present. Mention of the multitude of projects undertaken exceeds the space available, but included investigations at Gulf Island National Seashore, Fort Jefferson National Monument, Biscayne National Park, Canaveral National Seashore, Fort Matanzas National Monument, Castillo de San Marcos National Monument, and Fort Frederica National Monument. Simultaneously, many other student research projects unrelated to the NPS were undertaken throughout the region. A significant factor in this training is that it is multi-disciplinary, although usually dominated by archaeologists. Students receive opportunities to work on projects involving biology, geology, oceanography, and other traditional areas of field science; and even more arcane applications in diving psychology and physiology, crime scene investigation, and other areas. This inter-mixing provides a broad and synergistic training environment. In recognition of the potential for training in this

format, the Florida Sea Grant provided funding in 1986 to teach underwater research techniques as a pilot program, and a report and format outline for teaching such courses was produced (Stanton 1988).

During the 1970s the State of Florida undertook extensive investigations in Warm Mineral Springs (WMS) under the direction of Sonny Cockrell. Throughout the first phases of this work, until 1983, FSU students were involved in the project, obtaining project experience and FSU course credit, and Cockrell assisted as an occasional lecturer in the basic underwater archaeology course at FSU. After state funding and support for WMS was withdrawn in 1983, Cockrell received an appointment and office at FSU while he worked on obtaining further funding. When the project finally was funded in 1984, it was not through FSU, but the State University System. In 1987 the project was transferred to FSU, and continued there until funding was discontinued in 1993 (Cockrell 1990). During the latter portion of this second phase of the WMS project Cockrell was a co-instructor of the basic underwater research techniques class with Gregg Stanton and the author. He lectured on WMS in preparation for a field exercise conducted at the site, which was usually the University's major field project for the semester.

The NPS received funding for several major projects in southeastern national parks, which were conducted in cooperation with FSU. Among these were surveys at Biscayne National Monument in 1975 in support of a field assessment (Fischer 1975b), the 1983 investigations of the presumed site of HMS *Fowey* (Skowronek et al. 1987), and in 1984 a general survey and HMS *Fowey* site assessment (Wild and Brewer 1985). The last two projects were conducted as FSU underwater archaeological field schools. Major investigations also included Fort Jefferson National Monument in 1981 and 1982. The 1981 project was FSU research conducted from the Florida Institute of Oceanography's R/V *Bellows*, for the purpose of relocating and assessing the presumed site of *Nuestra Senora del Rosario*, a member of the 1622 Spanish Plate Fleet, and was a spring break exercise of the underwater research techniques class. The 1982 project, with NPS funding, involved mapping and test excavation of the *Rosario* site and was also an FSU field school (Johnson 1982). FSU provided support as well for a survey in 1980 in cooperation with the NPS-SCRU in search of the site tentatively identified as HMS *Fowey* (1748) (Fischer 1980).

This is only a partial overview of what one could term Phase I of FSU's involvement in the field. Phase II began in 1988 when the author took an early retirement from the NPS for medical reasons and developed a more formal and intensive involvement with FSU. They provided office space at the ADP, an expanded appointment at the Department of Anthropology, and increased responsibilities and involvement in FSU's programs. In the summer of 1988 Roger Smith, Florida State Underwater Archaeologist, conducted a re-survey of sites of the 1733 New Spain Fleet involving cooperative field schools of Indiana University and FSU. The purpose of this project was to reassess the 1733 wreck sites to locate a likely candidate for Florida's second Underwater Archaeological Preserve (Smith 1990; Smith et al. 1990). In the spring of 1989, FSU conducted major investigations of Wakulla Springs as a dedicated project of the underwater research techniques course for that semester (Fischer and Gerrell 1990). FSU has continued conducting limited duration survey and assessment projects, in a variety of circumstances: in some NPS areas, the Florida Keys National Marine Sanctuary, and other locales. In 1991, an involvement was developed with various individuals and agencies in Mobile Bay, and research was conducted on a number of sites, one of which is discussed elsewhere in this volume (Ball, this volume). Sites investigated include the French merchant vessel *Bellone* (1725), the Civil War blockade runner *Ivanhoe*, the Civil War ironclad CSS *Phoenix*, and the Confederate Obstructions of Mobile Bay. A listing of all FSU projects and activities of the past decade would

exhaust the space available, but suffice it to say they have been extensive and considerable. FSU has established itself as one of the first institutions in the country conducting underwater archaeology. The program has come a long way since those early research activities, to the point where a major program in underwater archaeology and scientific diving has evolved.

The addition in 1997 of Dr. Michael Faught as a full-time tenured faculty member to supplement several part-time appointees in various capacities, began a third phase. At the present time the curriculum has been expanded, and greatly increased field activities are anticipated. Recently the Program in Underwater Archaeology was awarded funding for two projects through the State of Florida's Historic Preservation Grants in Aid Program. Students in FSU's summer 1999 Underwater Field School will be able to participate in both, in order to become familiar with the archaeological techniques used on historic shipwrecks as well as submerged prehistoric sites. The first, the Dog Island Shipwreck Survey, will focus on the maritime resources in waters around Dog Island in the Gulf of Mexico off Franklin County. Two shipwreck sites are already located on Dog Island, and a number of others known to exist. Other resources, such as ballast dumps and the remains of a 19th century lighthouse, are also known in the area. The project is particularly concerned with the location of two historically significant shipwrecks: *LeTigre*, a French merchant ship that ran aground in 1766, and HMS *Fox*, a British schooner lost in 1799. The survey will utilize GPS-controlled magnetometer and side scan sonar remote sensing and the subsequent test excavation of any anomalies discovered. The 1999 fieldwork will begin in May and last for at least two months. The second summer research project is the PaleoAucilla Prehistory Project, directed by Dr. Faught. This major research project is an extension of other archaeological projects, such as the Aucilla River Prehistory Project and the Clovis Underwater Project, which focus on the submerged remains of Florida's first inhabitants. Using remote sensing technology to reconstruct the ancient river channel of the PaleoAucilla, which has been submerged since the end of the last Ice Age, FSU archaeologists will be working at a number of sites likely to have evidence of prehistoric humans. Summer 1999 research will continue excavation at the J & J Hunt site, located several miles offshore in Apalachee Bay. In 1998 this site produced both Archaic and Paleoindian artifacts. In addition, the team will survey new areas in the hope of discovering more submerged archaeological sites. The PaleoAucilla Prehistory Project's 1999 fieldwork will be based at the FSU Marine Laboratory at Turkey Point and is scheduled to last from late June to mid-August. It is anticipated these will be long term projects that can utilize the facilities of the Marine Laboratory while investigating nearby archaeological resources in a continuing program. Additionally, projects are under consideration in areas as far distant as Central and South America.

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

Introduction

In 1690 the War of the League of Augsberg was two years old and pitted a coalition of forces, including England under William of Orange, against French forces under Louis XIV. In the British North American Colonies the war was known as King William's War (McIntyre 1997:1) and was being conducted on a smaller scale but with equally grave impact on the antagonists. French and Indian parties had made a series of successful raids on New England outposts during the winter of 1689-1690. In response, New England forces under Sir William Phips successfully raised an attacking fleet and captured the French establishment at Port Royal in mid-May. Encouraged by their success, Phips organized an attack on Quebec which departed Massachusetts on 20 August 1690.

Following several delays and setbacks, an ill-prepared, disease-ridden, and tired fleet of approximately 32 vessels arrived at Quebec. It was 15 October and Phips prepared his strategy to face the Canadian forces under the legendary Governor of New France Louis de Buade, Count Frontenac. After a series of several encounters, skirmishes, and bombardments, it became evident that the New England forces did not have even a remote chance of taking Quebec. Realizing the hopelessness of the situation, Phips turned about and in the last days of October his fleet began an ill-fated return to New England in which four of his more than 30 vessels were lost.

One of the four vessels lost had no known survivors or location. Through a 1995 survey (Bernier 1996, 1997a), and further confirmed in the 1996 excavation (Waddell 1997; Bernier 1997b), Parks Canada's Underwater Archaeological Services had clearly established that they were working on one of the four vessels lost in the Phips expedition. More recent research strongly suggests that the wreck from Anse aux Bouleaux is that of the *Elizabeth and Mary*, a New England-built barque of 45 tons. The wreckage at Anse aux Bouleaux represents the earliest known New England-built vessel discovered to date.

The 1997 field season was the last year of excavation on the Phips' site, and this paper provides a preliminary summary of this work. As in preceding years, there were several partners in this venture including: the *Ministère de la Culture et des Communications du Québec*, the *Centre de Conservation du Québec* (CCQ), the Municipality of Baie-Trinité, the Regional Municipality of Manicouagan, and the *Groupe de préservation des vestiges subaquatiques de Manicouagan* (GPVSM). Regular on-site staff included Site Director Jim Ringer, three Parks archaeologists, and two contract archaeologists. These staff were very ably assisted by 32 volunteer divers from the GPVSM. These divers had all completed Nautical Archaeology Society Level 1 course work with Parks Canada. Results of this partnership were extremely gratifying with exceptional work performed by the volunteer divers. All on-site and temporary conservation was carried out by CCQ staff with 12 volunteers.

Project Goals

The three primary goals and labour divisions in the 1997 work plans were: (1) to complete excavation of the principal site; (2) to disassemble, raise and record the structural remains and finally; (3) to rebury the vessel. The site was endangered or threatened due to its extremely shallow depth (1 to 5 m), potential ice scouring, and almost complete exposure to on-shore winds. Exposure of timbers and artifacts was a continuing and evidently recent phenomenon. These factors had dictated the urgency with which the project had been brought online and the reason that the main site excavation had to be completed in 1997.

Underwater Archaeology, 1999:85–92.

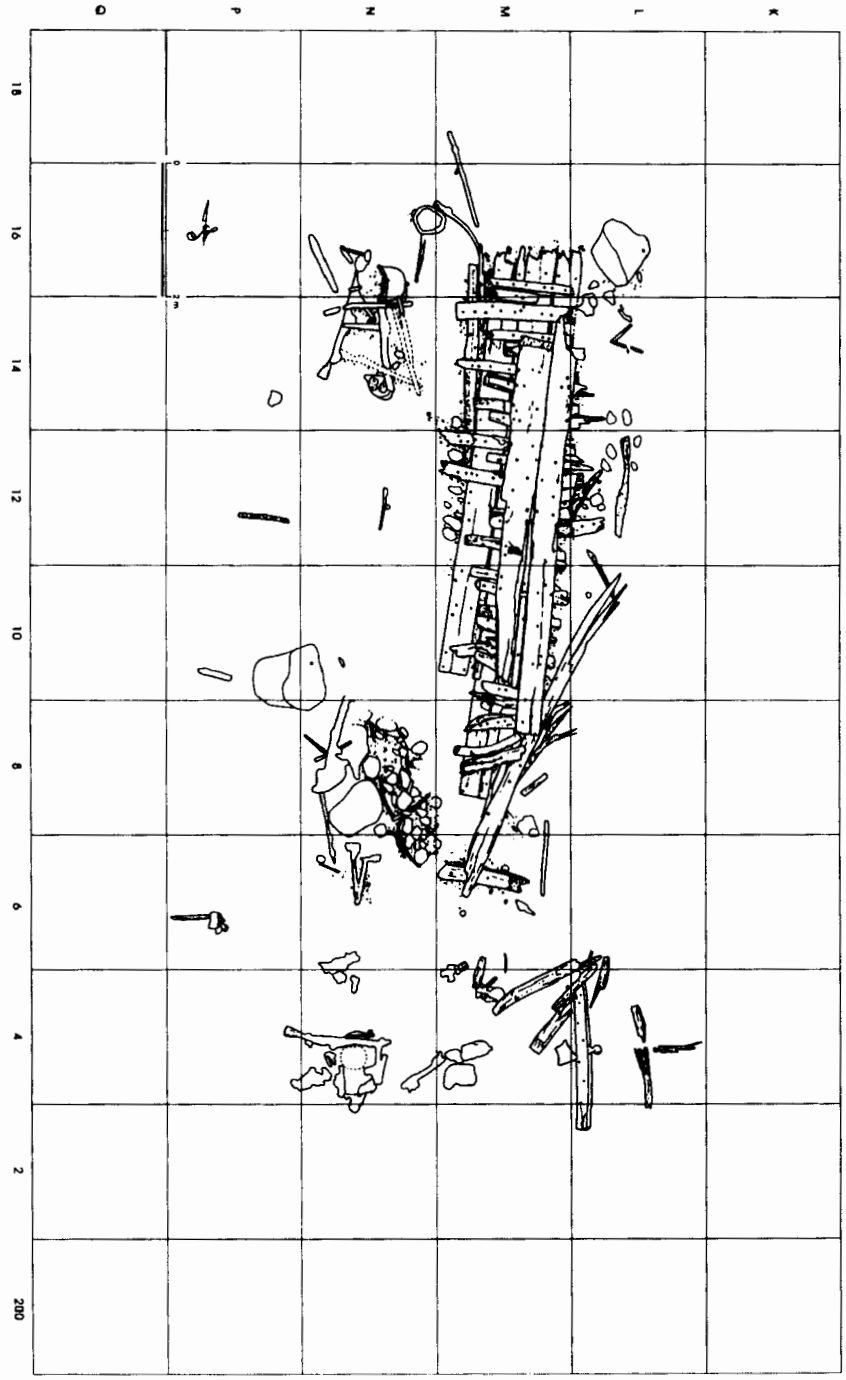

FIGURE 1. Final Site Plan 1997. (Drawing by P. Waddell.)

Site Setup, Operations, and Logistics

Direct work on the site took place over an 11 week period between 23 June and 10 September 1997. At the end of the 1996 season, the site had been backfilled extensively due to the dynamic nature of the immediate area. The hull had been ballasted with 900 kg of lead followed by approximately 60 tons of sand, almost equally divided between bagged and loose sand. On arrival at the site in 1997 it was evident that the site was considerably more covered with sand than it had been in 1996. The protection afforded the wreck and hull the previous winter was excellent. This result may have been as much good fortune as good planning, given the variety of effects winter storms can have on the shoreline.

The first week of operations was devoted to setting up the support barge over the site and dredging out the sand backfill. A sandbag dyke approximately 30 m long was laid just offshore, beyond the excavation limits in an effort to reduce infilling from offshore winds and inevitable storms. The second week of operations saw the datum reestablished, grids installed, and the commencement of excavation with six 4-in. dredges. Four Couple-jets with extended (7-9 m), off-site discharges were used along with two conventional discharge dredges. The area gridded and excavated was rectangular and approximately 20 x 8 m for a total area of 160 m^2 (Figure 1).

Total 1997 diving hours on site were 976. These hours were almost equally split between Parks Canada staff and volunteer divers from GPVSM. Many of the volunteer divers were returning for their second or third year and therefore were well acquainted with procedures and required little direct supervision. The quality of work done by this group of divers was exemplary. Approximately 80 percent of the total dive time was spent directly in excavation of the site; the remainder was devoted to site set-up, mapping, hull disassembly, and reburial.

Excavation and Artifacts

Stratigraphy noted in the 1997 excavation was quite similar to the 1996 findings although more sub-operations opened away from the main seabed concretions resulted in a recurring theme of 60 to 80 cm of sand followed by 10 to 40 cm of rock followed by a hard sterile gray clay. Artifacts were most frequently encountered just above and throughout the rock. Preliminary results indicate that some of the rock layer encountered was originally ship's ballast.

Concretion was evident over as much as 25 percent of the main excavated site area (Figure 1). Removal of this concretion was accomplished with short handled malls and cold chisels where possible. Normally this consisted of working the chisel face over the encased rocks in the conglomerate to free the artifacts. Pneumatic chisels were employed with very satisfactory results in the heavily concreted areas containing major associated artifacts. This was the primary tool used in the multi-musket and iron kettles areas of the site. A technique was developed of working down around the artifacts encased in the concretion by removing the encircling associated rocks with pneumatic chisels, small pry bars, and hand chisels. In working down around the concretion, the surface concretions were left intact. Once under the concretion, the underlying rocks and sand conglomerate were worked from outside towards the interior, which resulted in the bulk of the concretion being left supported by rock towers or pedestals. These pedestals consisted of rocks held together by concretion. The idea was to remove as much of the conglomerate as possible without losing any artifacts or concretion containing artifacts. Then, when the entire mass was of a reasonable size and weight for lifting, it was detached by removing key rocks in the pedestals. This was done by striking a key rock directly with a mall or in some instances using a chisel to get exactly the striking purchase required. Concretion fragments and any rock with

concretions attached were collected and kept in direct association.

Approximately 10 tons of concretion were recovered and taken to the field lab for processing. There, further reduction of the concretions was done jointly by archaeological and conservation staff. Single concretions weighing approximately 150 kg and measuring 1.75 x 1.40 m were recovered containing two or more intact muskets and/or equally delicate artifacts.

Artifacts recovered were processed at the field lab and temporarily stored. Statements made about artifacts and their distribution are preliminary since much of the material contained within concretions is not yet available for study. Field and lab x-rays continue to indicate artifacts not yet recorded. Conservation is projected to take several years for the excavation of artifacts from the concretions and actual conservation procedures.

Any analysis, preliminary or otherwise, must consider that there is only a portion of the hull and contents recovered. The wrecking details are unknown; but it is quite conceivable that some, if not all, persons on board reached shore and that salvage may well be reflected in the artifact assemblages.

Arms and Related Items

Muskets were the single-most common weapon recovered, numbering approximately 30. The majority of these long arms employed either a flint lock or similar flint ignition system. Specifically, a number of these firearms employed an "English" or "dog" style of lock which was developed during the first quarter of the 17th century. These locks were manufactured throughout the 1600s. There are a number of short, lightweight stocks which may be indicative of carbines, a relatively short style of weapon that was popular in the often closely wooded areas of North America.

At least three long-arm stocks possessed matchlock characteristics. One of the matchlocks illustrated definite evidence of conversion to a flint ignition system. Surviving attributes identify this firearm as an early arquebus. The stock is massive and extremely heavy and there is a thick, fish-tailed contour to the butt as well as a thin comb extending along the top of the butt terminating at an incised thumb rest. There is wear on the forestock indicating likely use with a fork rest. These attributes indicate that this is a weapon of substantial age, possibly dating prior to the 1630s.

Four pistols were also recovered but these have not yet been examined in any detail. Four swords were also recovered, one having a distinct robust cutlass-like style and another being a smaller, more refined gentleman's style sword or hanger.

Three distinct types of shot- or load-carrying gear were present including bandoleers, belly boxes, and cartridge pouches. Three bandoleers were recovered, one almost complete. The almost complete unit has at least 12 separate powder charge containers, or "apostles," which were suspended from a leather strap or belt. The apostles were metal vial-shaped containers with a leather covering. Black powder residue within indicated they had been in use. It appears that a pinked leather piece stitched to the belt portion of this artifact assemblage may have been a cover or protective flap offering protection for the apostles from the elements and also reducing any tendency to swing freely or get caught up in other paraphernalia. Entanglement would have been a real risk with bandoleers having typical double string suspension system on each apostle.

This style of load-carrying gear was in fashion by the early 1600s and known to be in use well into the latter part of the century. Wooden apostles were found on the *Belle*, one of LaSalle's vessels lost off the Texas coast in 1686 (LaRoe 1997). This style of load-carrying gear was issued until the beginning of the 18th century, although they likely would have been considered older technology. Also associated with the more complete bandoleer were elements of a ball bag in which the shot was carried and what appears to be a brown leather frog to accommo-

date a bayonet, sword or, most likely, a belt axe.

A fragile, but intact, belly box was recovered as well which contained 12 cartridges. These cartridges held only powder which indicates that shot was added separately in the loading procedure. The final type of load-carrying gear was marked by the presence of at least two cartridge pouches that were likely suspended from a shoulder belt, in contrast with the belly boxes which were secured by leather loops to a waist belt.

In charging the firearms, there is clear evidence of three distinct methods. There is standard loose powder charging as evidenced by the bandoleer apostles. Then there are cartridges containing only powder indicating prepackaged powder insertion followed by the projectile(s). Finally there is evidence of wrapped ball and powder cartridges that would have been inserted as a unit-again a variety of systems indicative of what individual militia personnel would have brought with them.

Over 2,000 individual shot pieces were recovered. There is considerable variation in the types of shot, including round and cylindrical varieties in the larger, more standard calibers. In the smaller shot there are round, cylindrical, and square varieties. Research on the unusual cylindrical shot indicates that this is a form of tumbled shot made by cutting or moulding lead into a disc or cylinder shape and then tumbling in a barrel to round off hard edges.

At least 15 belt axe handles or handle fragments were recovered. In addition, the mould of one belt axe head was salvaged from a concretion. Two handles contain drilled holes at the base to accommodate a leather thong. One handle had cross-hatched decoration on the shaft and butt accompanied by the owner's initials incised above the shaft decoration. In some of the colonies, militia were required to bring either a sword, bayonet, or hatchet. Although a limited sample, the preponderance of hatchets may not be surprising. Possibly the weapon most synonymous with warfare in the North American wilderness was the hatchet or belt axe—sometimes referred to as the camp axe or, popularly, tomahawk. Axes were more suited to campaigning in the wilderness than the less functional swords and bayonets.

A small collection of ordinance-related items were found, some through radiographs. Specifically, 15 ferrous metal, solid, round shot in at least three small calibres and, radiographic evidence of a breech block or breech chamber from a small calibre, breech-loading cannon. Interestingly, a small decorative or toy cannon was also recovered. It is 10 cm long and appears to be made of a copper alloy. This unique find has two pierced tangs on its underside similar to that seen on contemporary firearms furniture such as ramrod pipes and trigger guards. Such tangs indicate recessed attachment with a pin. Could this cannon represent a gross American underestimate of firepower required to defeat Canadians?

Ceramics

There are a total of 938 ceramic shards recovered to date. This number is increasing as concretions are treated. Within the collection there are eight identified groups or ceramic types as well as a small quantity of unidentified and modern wares. The most common ware, representing almost 80 percent of the collection, is Anglo-American brown-glazed redware which was likely made in New England. These are in the form of storage jars in two slightly different profiles. The other ceramic types all appear to be of European origin in both earthenware and stoneware, including a fragmented Bellarmine jug with bearded mask and medallion. One of the more notable finds was Staffordshire- or Bristol-style slip-combed earthenware in the form of a cup and a second unidentified object.

Although ceramic artifact analysis is just beginning, it is possible to comment on a few preliminary patterns. All redware found appears to have been in use for food storage. The very low number of shards in other ceramic forms would suggest that those on board had personal messing

property with them, possibly including treen which may have dispersed (floated) in the wrecking process. They may have been using some form of kit that was kept with personal effects or in a specific area on the vessel. This would not seem unreasonable for militia, particularly militia operating in cramped conditions in transport.

Other Artifacts

There were a variety of personal items including shoes, clothing, grease lamps, dividers, ivory combs, buckles, buttons, and coins. The variety of personal items and clothing reflects both what was seen as necessary for wilderness campaigning and social status of the expedition members. Shoes, for instance, include both sturdy laced types and more fashionable buckled examples. A group of over 30 pewter and brass spoons, many with personal markings, represents the entire range of styles popular through the entire 17th century.

The largest ship-related artifact found was an anchor stock recovered from the south end of the excavation in sub-operation 4L (Figure 1). The stock was made from Oak (*Quercus* sp.) in two approximately equal size pieces with overall lengths of 2.34 m and 20 x 22 cm cross sections. The two pieces are treenailed together at eight points through the length and there is no evidence of banding. An upper remnant of the iron shank is present but is not yet determined if the stock is keyed to it. Given the dimensions noted to date on the structure, it would not be unreasonable to suggest that this is one of the ship's bower anchors.

Hull Disassembly

The hull was disassembled in a series of steps which had been developed on the disassembly of Basque whaling vessels at Red Bay (Waddell 1986). The cleaned hull was initially photo and video recorded in individual shots and mosaics and then the ceiling planks were traced full scale. Following this the ceiling planking was removed using shimmed hydraulic jacks and nylon as well as other plastic wedges to pry the planks up enough to get clearance for pruning saws to severe the treenails. Flat iron chisels were also fabricated and used for severing treenails, a technique developed by the Texas Historical Commission in disassembling the *Belle*.

The exposed futtocks were then recorded with video and photomosaics. Virtually all of the futtock extremities had been previously mapped on the site structural plan and therefore a futtock-level tracing was not deemed essential. Disassembly of futtocks was initiated using standard wedging procedures as well as horizontal and vertical hydraulic jacking to raise the timbers off of the external planking. Treenails that remained in the external planks were removed by hand or saw cut, labelled in terms of provenience, and either recovered or attached to their respective planks. At this stage the inside face of the external planking was traced full scale and again mosaics in video and film were recorded. The exterior planking was then placed on lifting supports (padded aluminum ladders), lifted, and transferred to the field lab for interim immersion storage and hand recording. The hull disassembly took approximately 23 diving hours and the underwater tracing operations approximately 13 hours for a total estimated time of 36 underwater hours. This represents slightly less than 4 percent of the total 1997 dive time.

Wood identification was done on a total of 45 individual timbers from the wreck: 31 futtocks, 9 external planks, and 4 ceiling planks. All of these timbers are white oak (*Quercus* sp.), with the exception of one of the larger ceiling planks which is eastern white pine (*Pinus strobus L.*). White oak from Europe and North America, as

tested, are virtually indistinguishable. Eastern white pine on the other hand was found only in North America until it was introduced to Europe at the begining of the 18th century. Therefore, in terms of wood types encountered, there is nothing incompatible with what might be expected from a New England-built vessel of this period.

Site Reburial

It has normally been Parks Canada's practice to rebury ship timbers and selected artifacts at the excavation site, replicating their "as found condition" as closely as possible. At Anse aux Bouleaux this was not possible due to the exposed, shallow nature of the site. Initial thoughts were to then move further offshore to a depth of approximately 12 m. This option was eliminated because of potential ice action, decreased accessibility due to frequent high seas, and reduced security this far offshore. Conditions at several other points on the coast were checked but these also proved unsatisfactory, and finally an easily accessible, secure freshwater lake site was chosen. Although there could be some drawbacks to freshwater (seasonally warmer temperatures, etc.) the reburial will be complimentary to other salt water reburial studies underway. The site chosen was approximately 30 m from shore at a depth of 5 m. The bottom is extremely soft silt that exceeds 1.5 m in depth. A series of three overlapping tarps were laid on this soft bottom, covering an area 3.6 x 8 m.

The timbers were then placed on the tarp in three separate layers and mapped in terms of each timber's position to provide a final inventory and to aid in any possible selective timber recovery that might be undertaken. Each timber layer was separated by a sand layer of approximately 20 cm. Reburial mound walls were created with sandbags and essentially the same procedures developed in the ship timber reburials at Red Bay, Labrador, were followed (Waddell 1994). Monitoring or testing material was also placed in the mound: two water sampling tubes were placed centrally at either end of the mound to accommodate a Hydrolab Recorder, which is a water quality multiple logger, recording temperature, dissolved oxygen, standard pH, and specific conductance. Fresh oak wood samples were also placed in and outside the mound as part of an ongoing monitoring program.

Following the final sand layer, a 4 x 10 m, 36 mm hypalon tarp was unrolled over the mound and ballasted with sand bags to complete the operation. In total, 18 metric tons of sand were placed on the timbers over two days. The entire reburial took about 31 diving hours over a four day period or about 3 percent of the 1997 dive time.

ACKNOWLEDGMENTS

Preliminary analysis of the artifacts is being done by Parks Canada material culture researchers. For this publication Charles Bradley (Arms and related items), Phil Dunning (domestic artifacts), and Gerard Gusset (ceramics) are particularly thanked. This project would not have been possible without the local divers from GPSVM who worked in so dedicated a manner to protect and excavate the site. Organization and coordination of the volunteers was done by Marc-André Bernier. Marc Tremblay deserves special recognition for discovering the site and supporting the project.

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The Reassembly and Conservation of the *Belle*

Introduction

Of the 17th-century explorers, few stand out in history more than René-Robert Cavelier, Sieur de La Salle, better known today simply as La Salle. This Frenchman is noted both for his fur-trading activities in the Northeast and his exploration of the Ohio and Mississippi rivers. It is, in fact, the discovery of the mouth of the Mississippi River that is La Salle's most enduring accomplishment. In the name of King Louis XIV, it allowed him to lay claim to all of the lands that were drained by the Mississippi River. The significance of this discovery to the history of the United States is that this great land mass would become the Louisiana Purchase. When bought by the Americans from the French in 1802, it doubled the size of land held by the United States. Moreover, it was through this discovery that La Salle convinced Louis XIV to finance a colonization venture to establish a French settlement at the mouth of the Mississippi. Unfortunately, this enterprise set off a series of ill-fated events, including the wreck of La Salle's ship, the *Belle*, he and his men being stranded in Texas, the failure of his settlement attempt, and his death at the hands of his own men as he attempted to walk to Canada to get assistance for the colony (Foster 1998:1-48, 195).

The discovery in 1995 of La Salle's foundered ship, the *Belle*, which sank in Matagorda Bay, Texas, in 1686 (Weddle 1987; Foster 1998), received both national and international attention due to its historical importance (Arnold 1995). The ensuing excavation, directed by J. Barto Arnold III, then Texas State Underwater Archaeologist, was conducted as if the site were located on land. A double-walled coffer dam was constructed around the vessel, allowing the interior to be drained of all sea water (Figure 1). In fact, the *Belle,* fully loaded with cargo when it sank off the coast of Texas, contains one of the largest collections of 17th-century French artifacts ever excavated in the New World. Its conservation and reassembly is also proving to be one of the largest projects ever attempted in the United States. While the focus of this paper is on the reassembly and conservation plan of the hull of the *Belle*, it is important to note how much of this part of the project is being funded.

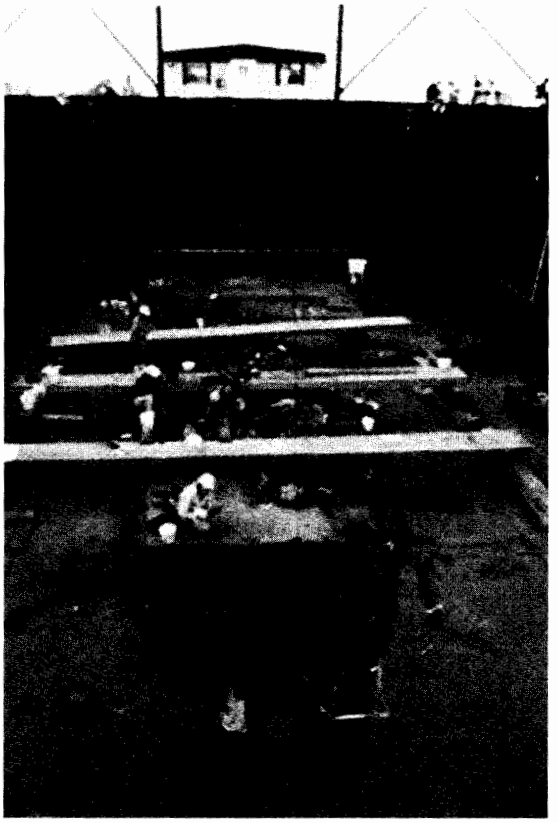

FIGURE 1. The *Belle* being excavated within the drained coffer dam.

Before the initiation of the ship's excavation, the Texas Historical Commission arranged for the Conservation Research Laboratory (CRL) of the Nautical Archaeology Program at Texas A&M University to treat, preserve, and conserve all of

Underwater Archaeology, 1999:93–97.

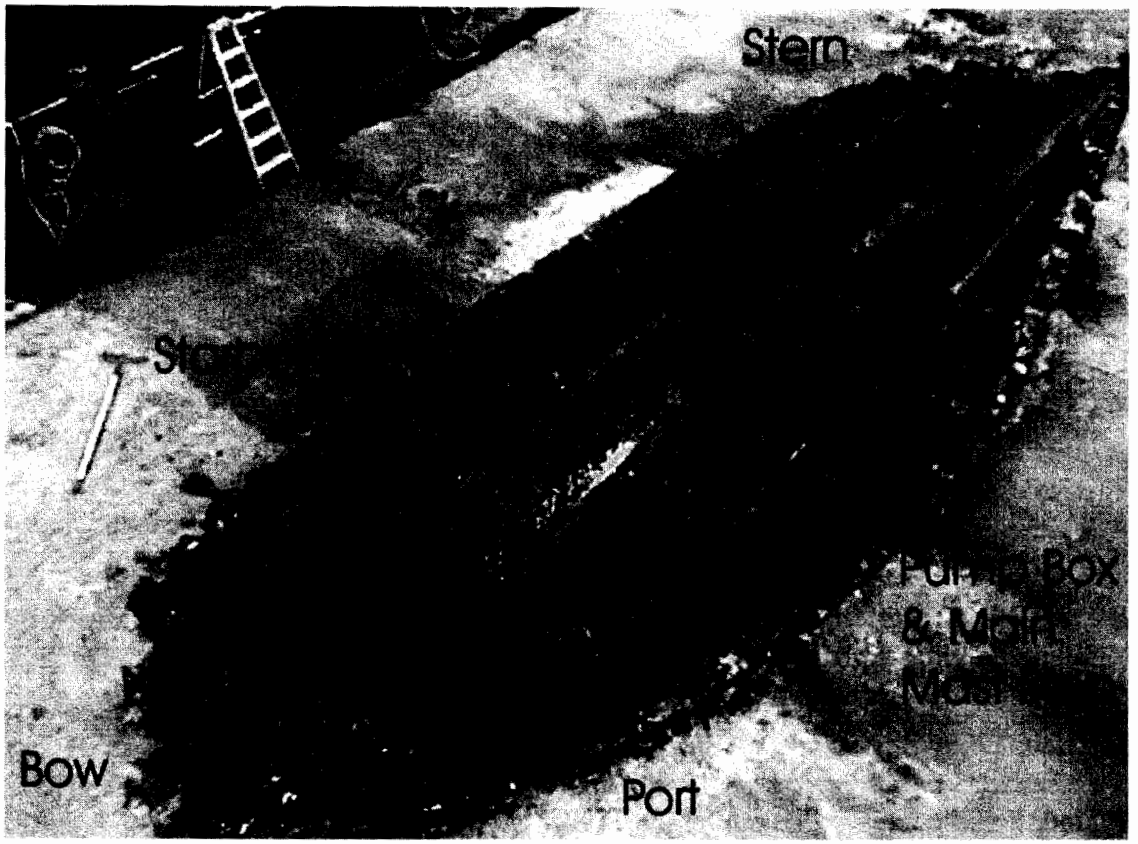

FIGURE 2. The excavated hull of the *Belle* just prior to being disassembled.

the recovered material. This included the hull itself, for the ship, just like a single bead, is also an historic artifact, and in this case is the most important piece from the site. It soon became evident, however, that there was not enough money available to fund the conservation phase of the La Salle Shipwreck Project. Considerable additional support from other sources was required. Fortunately, the excavation of the *Belle* was highly visible, with thousands of the interested public allowed to visit the site and view the on-going work. The project was also given much national media attention, so acquiring extra funding and corporate support was a much easier task.

The key to obtaining this support was to ensure that the activities conducted at CRL were as high-profile and visible as was the field excavation. With the growth of the importance of the Internet in the dissemination of information, a series of web pages were written, detailing various aspects of the conservation procedure (see http://nautarch.tamu.edu/napcrl.htm). The web presence has not only allowed researchers to present the historic significance of the project, but it is proving to be instrumental in gaining

support and funding from corporations for wages and much-needed supplies. The web pages also validate CRL by showing it to be part of Texas A&M University and its present association with the Texas Historical Commission.

As noted above, the hull of the *Belle* is the most important artifact from the site (Figure 2; thus its conservation had to be carefully planned. Initially, some thought was given to lifting the hull intact out of the coffer dam, but since the site was some distance out in Matagorda Bay and the conservation laboratory was more than a 100 mi. inland, it was decided to completely disassemble the ship in situ. As such, the *Belle* was delivered to CRL in 381 pieces. There it will be cleaned, documented, and conserved. Some basic questions had to be answered quickly: (1) How would the project be set up? (2) How will the hull of the ship be documented and conserved? (3) Considerable media and public attention was maintained throughout the excavation. How best could this attention continue throughout the much longer and equally expensive conservation stage of the project? (4) How could the conservation of the hull be improved, and if possible, the time required to do it be shortened?

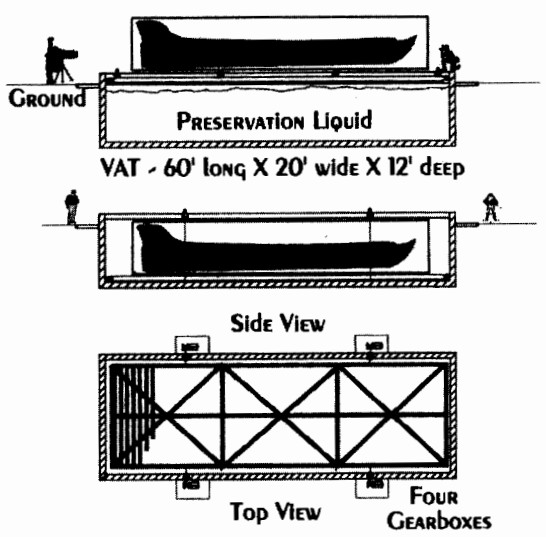

FIGURE 3. A schematic drawing of the wood conservation vat being built to conserve the hull of the *Belle*.

Just as the concept of constructing a coffer dam around the ship and excavating it as a dry land excavation ensured that the project would attract much media attention, an equally imaginative approach was devised that would assist in the analysis and the conservation of the *Belle*'s hull. After much thought, it was decided that a large outside vat should be constructed. This vat would be made to hold the reconstructed ship prior to conservation.

A short distance from the Conservation Research Laboratory, an open space existed in which there could be built a 60-x-20-x-12-ft. concrete vat with a lifting frame that would support the ship during reassembly and conservation. At any time during the reassembly and conservation, the entire ship could be raised into view. By having the ability to lift the ship in and out of the vat at will, the "out-of-sight problem" that is encountered when most ship hulls are conserved was eliminated (Figure 3). Some statistics on the vat include: (1) 400 yd^3 of concrete were used for its construction, (2) 15 tons of steel re-enforcing rods were used in the floor and walls, (3) to prevent any cracking, there are no perforations in the concrete walls and floor, (4) four cantilever platforms along the sides of the vat will support the electric motors and gear boxes to raise the lifting frame that will support the ship, (5) the frame is designed so that it will only deflect a maximum of 1 in. over the 60-ft. length, (6) a French drain is placed along the side of the vat to pump out any ground water, (7) when filled, the vat will hold 96,000 gallons of water, (8) it will take 7,680 pounds of polyethylene glycol (PEG) to raise the concentration 1 percent, (9) a light-weight, removable roof will be in place during conservation, (10) costs have been considerably decreased by ensuring many of the components (lifting frame, motors, gearboxes, pulleys, cables, pumps, etc.) and the engineering designs are donated, and the construction is done at cost. The finished vat will

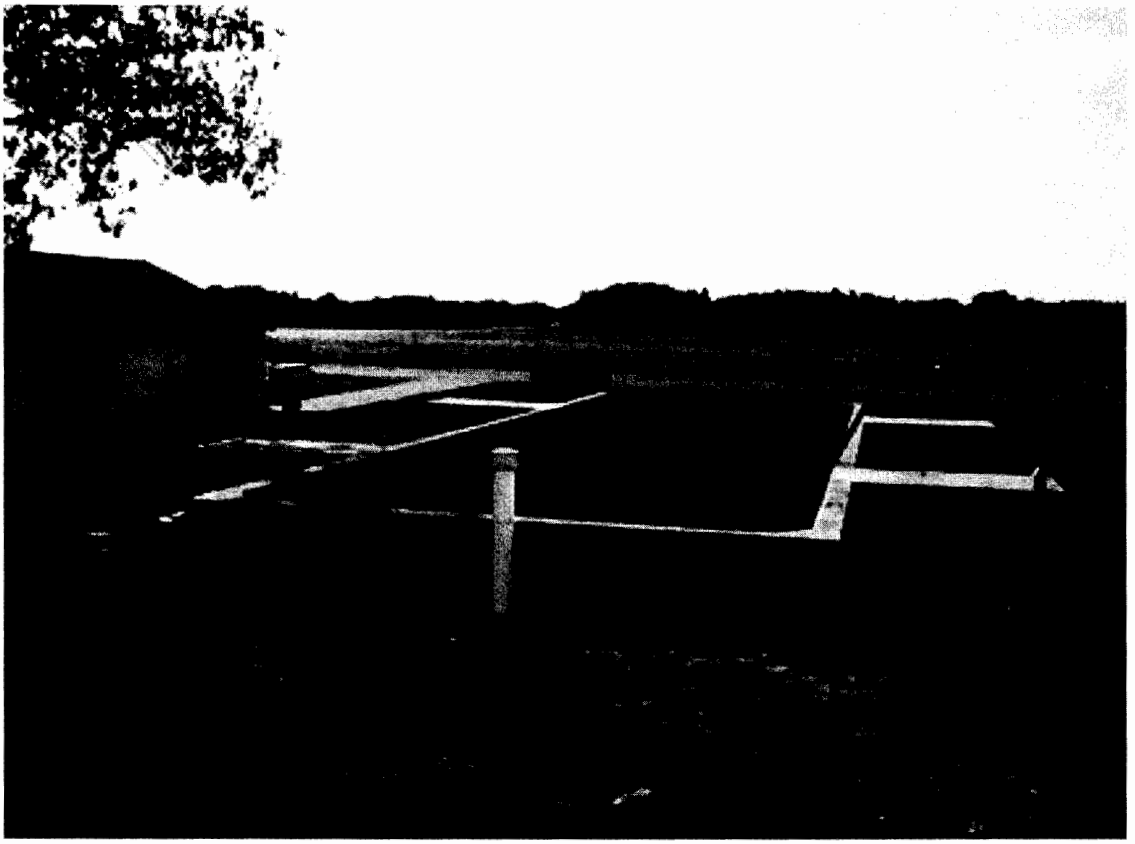

FIGURE 4. The wood conservation vat with a French drain and four cantilever platforms for the motorized gearboxes to lift the hull on the lifting platform. The lifting platform is not yet installed.

be the largest wood conservation facility in North America (Figure 4).

In preparation for the reassembly of the *Belle*'s hull, all of the pieces will be first carefully cleaned. This will include the removal of all sawn-off tree nails and any remnants of iron spikes and bolts. Following this, each piece of the hull will be carefully recorded. The vessel will then be reassembled according to the ship's lines drawn for the ship.

Conservation Treatment

At present, an ambient temperature aqueous PEG treatment is planned with the hope of cross-linking it at the conclusion of the treatment. This will cut down on the hygroscopicity of the PEG, thus lowering its concentration. The lower the PEG concentration, the shorter the conservation time and the less cost involved in the project. In addition, the conserved weight of the

hull will be lessened. Details on whether or not a two-stage treatment of 30 percent PEG 400 followed by 30 percent PEG 4000 or the use of specially engineered PEG more susceptible to cross-linking has not been finalized.

Reasons for Reassembling the Hull Prior to Conservation

(1) In the field, the intact hull could not be recorded with the precision that can be achieved in the laboratory; (2) during the wrecking of the ship, the keel was broken, distorting the original ship's lines; during the reassembling, this distortion will be compensated; (3) one learns as much about the construction techniques by putting it back together as obtained during the excavation and disassembly; (4) being able to complete both (1) and (2) above allows researchers to obtain up front all of the data on the hull, and not five or more years later, when it may be that no one is around that took part in the excavation; (5) when the individual elements of a ship are conserved they each undergo differential degrees of shrinkage and warping, making it is usually quite difficult to reassemble the hull; if assembled and then conserved, each piece has to react in conjunction to the elements to which it is attached; (6) with the ship being reassembled on a lift whereby it can be brought up in complete view is a way of maintaining public and media attention, which will allow the project to continue to raise money and donations of supplies for the conservation.

At each stage of the La Salle Shipwreck Project, imaginative, ground-breaking approaches have been taken in the field excavation and in the conservation. As researchers prepare to begin the conservation treatment, they are planning ahead for the display of the conserved hull. How can the hull be most effectively presented? What technological innovations have been developed in recent years that will allow us to design a support cradle that will showcase the hull with few visual barriers. For example, while final plans have not yet been made, researchers are exploring the use of carbon fiber to support the frames and outer planking.

A Regional Wood Conservation Facility

Throughout the year, the conservation facilities of CRL are made available to different projects on a cost basis. Numerous types of archaeological conservation procedures are performed. At the conclusion of the conservation of the *Belle*'s hull, the wood conservation facilities will be available for any project—large or small—requiring a conservation facility to treat the recovered material. Considerable cost will be saved, since the equipment is already in place, the chemicals are on hand, and the procedure is established. The use of regional conservation facilities will make conservation more cost-effective and will eliminate the wasteful practice of constructing conservation facilities for a single project and then dismantling the facility. The conservation facilities at the Nautical Archaeology Program at Texas A&M University are there for on-going projects and for projects of the next millennium.

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Silicone Oil: A New Technique For Preserving Waterlogged Rope With Passivation Polymers

Introduction

In 1996, the Texas Historical Commission excavated René Robert Cavalier, Sieur de la Salle's vessel *La Belle*, which had sunk in Matagorda Bay, Texas, in 1686. The fine sediments in the bay floor facilitated the preservation of the lower portion of the wooden vessel, its cargo, the personal belongings of its crew, and an assortment of supplies necessary to start a colony in the New World. Among the organic materials recovered were lines from *La Belle*'s rigging and coils of rope that had been stored in its hold. The conservators of *La Belle* have been faced with the formidable task of conserving the large amount of hemp rope recovered from the vessel, which includes segments more than 100 ft. (30.5 m) in length. Of particular challenge to the conservators is the vessel's anchor line which consists of a continuous section of rope over 500 ft. (152 m) in length. The diameter of these sections ranges from 6.25 to 6.6 cm, after conservation. Although the majority of the recovered rope appeared to be in pristine condition during excavation, microscopic analysis has indicated that most of the fibers are thin and visibly degraded; microbial action and water saturation has caused them to weaken and decay.

Methods

Silicone Treatment Strategies

The Texas A&M Archaeological Preservation Research Laboratory technique for stabilizing waterlogged rope with silicone oils involves a displacement of the water trapped in the rope fibers with acetone, followed by the replacement of the acetone with a hydroxyl-ended functional polymer and crosslinker. The polymer-impregnated rope is then cured by exposure to a catalyst that is applied either topically to the rope or as a vapor. The authors suggest that the resultant preservation of the treated rope is a result of surface consolidation, the penetration of hydroxyl-ended polymers with the addition of crosslinking agents, and final treatment with a tin-based catalyst to complete the polymerization process.

The Frankfurter Method of Rope Preservation

Conservators at the National Museum Conservation Laboratories in Brede, Denmark, routinely use a technique for conserving waterlogged rope that they refer to as the "Frankfurter Method" (Koefoed et al. 1993). This process involves encapsulating waterlogged rope between sheets of perforated polypropylene film that are heat sealed to produce a form-fitting jacket in which each sample remains throughout treatment. The packaged rope is attached to a piece of Masonite (TM) which acts to support the rope. The resultant packaged rope is then treated with polyethylene glycol (PEG). Following treatment, the rope is placed into a large freeze-drying unit and freeze dried at -20°C with a 50 percent relative humidity. After freeze drying, the rope sample is removed from the Masonite/polyethylene bag structure and allowed to sit in fresh air. Rope specimens that are treated with the Frankfurter Method often require additional treatment with applications of polyurethane in ethylacetate (Koefoed et al. 1993). This is necessary because the rope is often extremely delicate after processing. Rope treated with the Frankfurter Method retains its pre-treatment color and the individual fibers (yarns and strands) that comprise the rope are well preserved. Like other successful treatments for severely deteriorated waterlogged rope, this process is generally not reversible due to two factors. First, the application of polyurethane in ethylacetate is generally not reversible. More important, however, is the fact that most treated rope samples are very friable and desiccated af-

Underwater Archaeology, 1999:98–106.

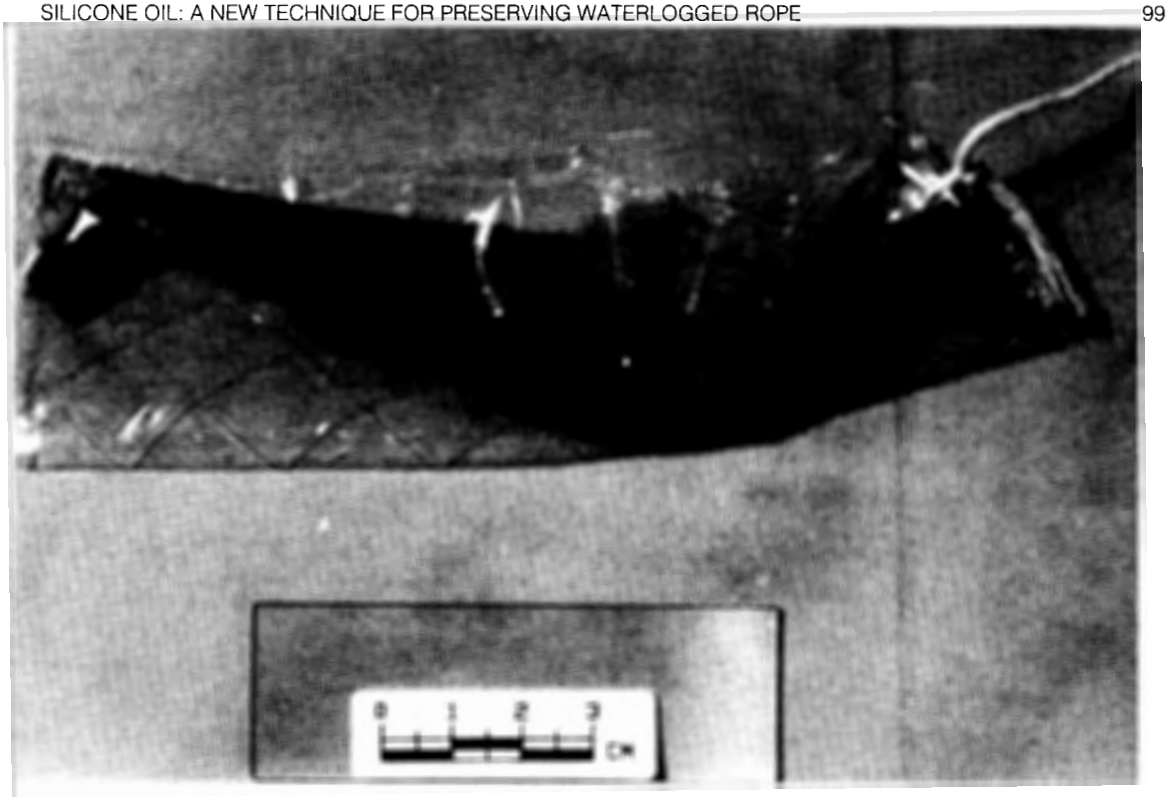

FIGURE 1. Treated sample encased between sheets of Ziploc vegetable bag material.

ter treatment, making additional treatment difficult.

Treating Waterlogged Rope in a Non-Polar Suspension Medium

Experiments conducted by the National Museum Conservation Laboratories have also demonstrated that treating waterlogged rope with PEG in a volatile, non-polar solution such as ether or kerosene enables the individual fibers of the rope to "float" during treatment, facilitating thorough impregnation of the PEG within the matrix of the rope. The use of suspension mediums in PEG treatments results in rope specimens which lack the characteristic matted appearance of rope treated with PEG alone; the resulting rope, however, is extremely fragile and very susceptible to environmental changes.

Incorporating the Use of Non-Polar Suspension Mediums and Elements of the Frankfurter Method into "Traditional" Silicone Treatment Strategies

Experiments conducted with silicone oil treatments at the Archaeological Preservation Research Laboratory have demonstrated that treating waterlogged rope that has not been enclosed in some form of permeable material results in a specimen that tends to unravel slightly during treatment. The authors believed that the polypropylene jacket used in the Frankfurter Method would provide a permeable membrane that facili-

tates chemical transfer and also acts to protect the physical integrity of the artifact during treatment.

Furthermore, after observing the results of experiments conducted by the National Museum Conservation Laboratories on the use of suspension mediums in the treatment of waterlogged rope with PEG, the authors anticipated that the use of a suspension medium during the polymerization of waterlogged rope would alleviate the slightly matted appearance commonly observed after silicone oil treatments that do not involve the use of a non-polar suspension medium.

Experimental

The following procedure is but one example of the use of preservation polymers in conservation. For researchers in the field of conservation, exploration with other silicone preservation polymers and crosslinkers is recommended in order to determine the resultant attributes of varying combinations of these invaluable materials.

The majority of rope recovered from *La Belle* was transported to the Texas A&M University Conservation Research Laboratory, where it is stored in fresh water awaiting treatment. Three samples of rope of similar length were taken from a single continuous coil. Two of these samples were to be treated by the proposed hybrid silicone treatment process (samples *Si-1* and *Si-2*), while the third sample (*WL*) would be allowed to air-dry at room temperature for a 24 hour period.

The samples were rinsed in fresh running water for two days to ensure the removal of soluble salts. The samples were then placed on a sheet of glass for additional manual cleaning. During this process, the samples were positioned beneath a constant, gentle flow of tap water in order to keep the rope wet while debris was flushed from its surfaces. Like the majority of rope from the *La Belle* assemblage, the samples were partially covered with black and dark brown sulfide stains. These stains resulted from the fact that the cotton cloth in which the rope had been transported from the site to the laboratory had decayed en route. Most of these stains were removed by lightly rubbing the affected areas with a cotton swab. No attempts were made to remove deeply-set stains by chemical means as it was feared that additional chemical additives would interfere with the conservation process.

The samples that were to undergo silicone treatment were each placed between two sheets of perforated polyethylene film, which is scored with uniform holes that allow water, acetone and silicone oil to freely diffuse (Figure 1). These sheets of polyethylene film were then heat sealed, creating form-fitted, ventilated bags in which the ropes would remain throughout the initial stages of treatment. Ziploc (TM) brand Vegetable Bags are an ideal source of perforated polyethylene film; they are readily available and easily sealed to form a pouch, using either a heat sealing appliance or a small soldering iron and brown paper.

The encased ropes were each placed into a beaker containing 500 ml of fresh acetone. At room temperature, a vacuum of 3999.66 Pascal (30 mm) was applied to the samples in acetone to induce rapid displacement of the water with acetone. The samples initially bubbled rapidly as air and acetone were driven from the internal structures of the rope. After approximately 20 minutes, the rapid bubbling ceased and smaller, more infrequent bubbles were observed escaping from the ropes. The samples were then removed from the water-laden acetone and placed into clean beakers containing 500 ml of fresh acetone. Each beaker was returned to the vacuum chamber and a vacuum of approximately 5332.88 Pascal (40 mm) was applied. Once the bubbling ceased, the ropes were removed from the vacuum chamber and allowed to sit at ambient pressure and room temperature while the silicone oil/crosslinker solution was prepared.

With the water/acetone exchange process complete, the next phase of treatment was to exchange the acetone with an appropriate silicone oil/crosslinker solution. In this process, the polymer and crosslinker are specifically chosen to

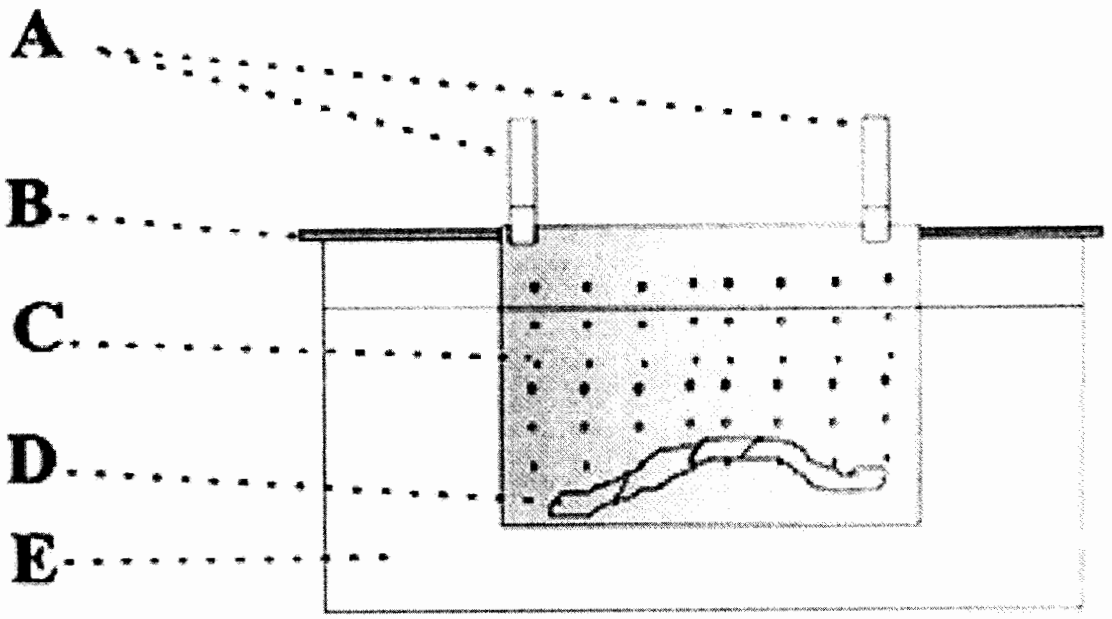

FIGURE 2. Rope sample suspended in kerosene/CT-32 solution: (a) clothes pins; (b) dowel spanning the vat; (c) perforated polyethylene mesh; (d) silicone impregnated rope suspended in mesh; (e) vat containing kerosene/CT-32 solution.

produce a desired texture and strength. To maintain flexibility in the treated rope samples, two hydroxyl-ended silicone oils were blended together in a 50:50 solution, by weight. The lighter of the two polymers is a Corcoran Laboratories product known as PR-10, which is a low viscosity hydroxyl-ended fluid. Repeated experimentation indicates that lighter molecular weight silicone oils such as PR-10 tend to penetrate easily into organic materials such as rope; once polymerized, however, they tend to produce a rigid artifact. Corcoran Laboratories PR-12 is a slightly more viscous hydroxyl-ended fluid with a larger molecular weight than PR-10. Because of the porosity of the waterlogged rope, larger molecular weight polymers such as PR-12 are expected to easily permeate the matrix of the rope samples. Due to its increased viscosity, PR-12 acts as a consolidant by keeping loose strands together; furthermore, rope that has been treated with PR-12 tends to be more flexible after treatment than rope treated with smaller molecular weight polymers. A blend of these two silicone oils was used for this experiment to ensure that the finished product maintained a degree of flexibility as well as internal rigidity and physical strength. Passivation Crosslinker CR-20, 3 percent by weight, was added to the PR-10/PR-12 silicone oil solution. CR-20 is a highly efficient crosslinker that experience has shown to work well with silane polymers.

After placing the dehydrated ropes in clean beakers, a sufficient amount of the silicone oil/crosslinker solution was added to each beaker in order to immerse the samples in solution. Aluminum mesh was securely fixed over the packaged ropes in order to prevent them from floating to the surface of this viscous mixture. A vacuum of 5332.88 Pascal (40mm) was applied to the samples in solution for 20 minutes to en-

TABLE 1
DATA FOR THE AIR DRIED ROPE SAMPLE

Time	Weight/g	% Change	Width/ cm	% Change	Length/ cm	% Change
Before Air Drying	12.2g	----------	1.516cm	---------	9.788cm	----------
1 hour Air Drying	3.10g	-74.590%	1.480cm	-2.374%	8.761cm	-10.492%
3 hours Air Drying	2.82g	-76.885%	1.472cm	-2.902%	8.751cm	-10.594%
5 hours Air Drying	2.70g	-77.868%	1.472cm	-2.902%	8.642cm	-11.708%
24 hours Air Drying	2.70g	-77.868%	1.472cm	-2.902%	8.531cm	-12.842%

	Pre-Treatment	Post-Treatment
Texture	soft-mushy	brittle
Integral Strength	fragile	friable
Color	10YR-2/2 very dark brown > 10YR-2.1 black	5YR-6/2 > 5YR-5\2 pinkish gray

*Color determined using a Munsell soil color chart, 1975 edition

sure that the acetone present in the rope fibers would vaporize rapidly, facilitating a thorough penetration of silicone oil solution throughout the artifacts. During the initial stages of vacuum treatment, large bubbles were observed escaping from the ropes. After 30 minutes this rapid bubbling diminished and sporadic small bubbles were observed rising from the artifacts.

The packaged ropes were then taken out of the vacuum chamber and allowed to sit in solution at ambient pressure and room temperature. After sitting for two hours, the samples were removed from the silicone oil/crosslinker solution and from their perforated polyethylene bags. The samples were placed on an aluminum screen to allow drainage of excess free-flowing silicone oil solution. After one hour, the surfaces of the ropes appeared to be reasonably dry and the artifacts were placed in beakers containing 500 ml of fresh CR-20 crosslinker. The authors have found that immersion in CR-20 after bulking the samples with a silicone oil/crosslinker solution is helpful in removing additional silicone oil solution from the external surfaces of the rope. While immersed in the crosslinker, a soft brush was used to wipe the rope surfaces in order to facilitate removal of excess silicone oil solution. After five minutes of immersion and surface

TABLE 2
DATA FOR THE SILICONE TREATED ROPE SAMPLE

	Measurement	Average	% Change
Pre-Treatment Length / cm	14.308	14.228	-1.118
Post-Treatment Length / cm	14.148	-------	-------
Pre-Treatment Width Number Si-1 / cm	0.9280	.922	-1.293
Post-Treatment Width Number Si-1 / cm	0.9160	-------	-------
Pre-Treatment Width Number Si-2 / cm	0.9380	.932	-1.386
Post-Treatment Width Number Si-2 / cm	0.9250	-------	-------
Pre-Treatment weight / g	16.597	11.499	-61.438

Post-Treatment Weight / g	6.4000
Pre-Treatment Color*	10YR-2/2 very dark brown-.10YR-2.1 black
Post Treatment Color*	10YR-6/3 pale brown->10YR-4/3brown
Pre-Treatment Flexibility	limp, almost formless, individual strands indistinguishable
Post-Treatment Flexibility	dry, individual strands visible, slightly stiff

*Color determined using a Munsell soil color chart, 1975 edition

FIGURE 3. Silicone oil treated rope *Si-1*.

preparation, polymerization was initiated by exposing the rope sample to a tin-based catalyst.

The samples were placed into loose perforated polyethylene bags and the bags were heat-sealed shut. The sample packages were each suspended with two wooden clothes pins from wooden dowels. These dowels rested on the top edges of a small vat containing kerosene with CT-32 tin catalyst, 3 percent by weight (Figure 2). The open structure of the mesh bag evenly exposed the surfaces of the rope to the kerosene/catalyst solution. With the samples suspended in the solution, the vat was placed into a vacuum chamber and a vacuum of 5332.88 Pascal (40 mm) was applied. After 20 minutes under vacuum, the valves of the chamber were locked and the rope was left suspended in the solution overnight. The following morning, the vacuum chamber was returned to ambient pressure and the samples were removed from the kerosene/catalyst solution.

The rope was removed from the perforated polyethylene bags and placed on several paper towels, which absorbed the kerosene/crosslinker and silicone oil solutions from the artifacts. Immediately following removal from the kerosene/crosslinker solution, the surfaces of the cordage were covered with a thin, slippery coating of silicone. After a few minutes of exposure to fresh air, droplets of fully cured polymer were observed on one end of the samples. These were easily removed using a soft, lint-free cloth. After allowing the rope to air-dry in a vented fume hood for 24 hours, the surfaces of the samples appeared dry and very natural in texture.

In order to determine the degree of deterioration caused by waterlogging, as well as to compare the results of the silicone-treated rope against an untreated specimen, *WL* was weighed, measured and allowed to air-dry at room temperature in a vented fume hood for 24 hours (Table 1).

Results and Discussion

The silicone oil-treated rope samples feel slightly stiff. These samples however, are very stable and aesthetically pleasing. The individual fibers, yarns, and strands of the silicone-treated rope samples were easily distinguishable after treatment and did not become matted and compressed after preservation using silicone oils. The high degree of visible detail in the silicone-treated samples was surprising because these features were indistinguishable in a water-logged state. Furthermore, while it may be impossible to determine the original color of the waterlogged rope, the post-treatment coloration of the silicone-treated samples was acceptable, ranging from a pale to mid brown (Table 2). Figure 3 is a photograph of sample *Si-1*. Prior to treatment, this sample was loosely twisted. Following treatment, no discernable changes were observed in

the twist or physical dimensions of either silicone oil-treated rope sample.

Post-Treatment Strength

After one week of air drying, the silicone oil treated rope and the comparably-sized sample of air-dried rope were taken to the Texas Engineering Experiment Station, Testing Machinery and Repair Laboratory at Texas A&M University for tensile strength testing. We believed that these tests would provide us with insight into the strength characteristics of polymer-treated rope. Tensile strength testing was conducted with a 20 kip (1 kip = 1000 lbs. tensile strength) MTS servo-hydraulic frame, which measures the maximum load breaking point of materials. To more accurately measure the maximum load breaking point of low-potential tensile strength materials such as the fragile treated *La Belle* rope fibers, a 2 kip load cell was mounted into the jaws of the 20 kip machine.

Data control and acquisition was recorded using Gardner Systems software. Time, distance, and pounds force were measured for each sample. In each test, tensile strength testing continued until the sample failed. Rope 1 (*Si-1*), treated with silicone oils, was mounted in the load frame using wedge grips. This sample slipped once during testing. To prevent slippage with the other samples, the second silicone-treated rope sample (*Si-2*) and the freeze-dried sample (*WL*) were mounted into the load frame using wedge grips only after being outfitted with epoxy potted ends. This is a more complex mounting process that requires that the ends of the rope be cemented into a cone-shaped epoxy base prior to mounting in the frame. The use of these potted ends eliminated slippage and resulted in more reliable data.

Tensile strength testing has demonstrated that rope preserved in silicone oil is considerably stronger than rope that has been allowed to air-dry. When tested, the rope section *WL* failed at 2.6 lbs tension and the sections of rope treated with silicone oils, labeled *Si-1* and *Si-2*, failed at 36.5 lbs and 27.7 lbs respectively. Table 3 lists the data acquired from this tension test. As a result of waterlogging, which deteriorated and weakened individual fibers of the rope, the strands that make up the rope failed at different times in each of the samples. While post-treatment strength may not be an important factor in the decision to conserve rope by a particular method, it is beneficial to know that silicone oil-treated cordage is more internally stable and stronger than rope that is not treated with silicone oil.

Effectiveness of Incorporating Non-Polar Suspension Mediums and Elements of the Frankfurter Method into "Traditional" Silicone Treatment Strategies

The Danish process of using perforated polypropylene film to make a form-fitting jacket within which archaeological rope is treated (an approach most commonly utilized in the Frankfurter Method) worked well when incorporated into our silicone treatment. The polypropylene jacket provided a permeable membrane that facilitated chemical transfer and also acted to pro-

TABLE 3
TENSILE STRENGTH DATA FOR ROPE SAMPLES

File	Type	Peak Load (lbs)	Comments
Rope 1	Si-1	36.5	Wedge grip mounted
Rope 2	Si-2	27.7	Epoxy potted ends
Rope 3	WL (air-dried)	2.6	Epoxy potted ends

tect the physical integrity of the artifacts during treatment. Through experience, we have found that rope treated without being enclosed in some form of permeable material, such as a perforated polyethylene bag, tends to unravel slightly during treatment. Silicone oil-treated rope treated without a non-polar suspension medium such as kerosene usually results in an artifact with a slightly matted appearance. Immersion in a non-polar solution enables the fibers to "float" and facilitates the polymerization of individual fibers. The use of kerosene with a tin-based catalyst works well as a medium for polymerization, but the kerosene/catalyst polymerization medium is not ideal for routine laboratory use due to the flammable nature of kerosene. An additional disadvantage in using a kerosene/catalyst medium for polymerization is that it takes several days for the faint odor of kerosene to be eliminated from the artifact. We fully expect that other volatile solvents will work well in place of kerosene, but these experiments have yet to be conducted.

Experimentation has indicated that CR-20 crosslinker/CT-32 catalyst, 3 percent by weight, solution is also an effective and safe substitute for the kerosene/catalyst mixture. After removing treated samples from the CR-20/CR-32 catalyst solution, the surfaces of the rope were not slippery, suggesting that more complete catalysis occurred while the sample was in solution. Unlike the kerosene, residual odors associated with this catalyzation medium dissipated in a matter of minutes once the sample was exposed to fresh air.

After silicone oil/crosslinker solutions have been impregnated into organic materials, immersion in CR-20 crosslinker and surface wiping with a cotton swab or a lint-free cloth is an effective way to remove excess polymer from the surfaces of an artifact. In some cases, excess silicone oils have been removed from the surface of rope by immersion in CR-20 crosslinker under a slight vacuum. The process appears to eliminate a great deal of silicone oil solution from within the deep crevices and voids on the surface of the rope.

Obvious benefits of using silicone oils for conserving waterlogged rope include the short treatment duration and the minimum amount of laboratory equipment required for the process; PEG/freeze-drying methods of rope preservation require substantially more time and labor. The silicone oil-treated examples were conserved in less than 24 hours. In addition, artifacts treated with silicone oils do not require special curation and, as the data suggests, the dimensional attributes of the artifact are accurately preserved.

As Vera De la Cruz Baltizar observed in her (1996) thesis entitled "Plastination as a Consolidation Technique for Archaeological Bone, Waterlogged Leather and Waterlogged Wood," silicone-oil treated samples appear to be dimensionally stable with good coloration (Baltizar 1996). Repeated testing of the hybrid silicone-oil treatment described above at the Archaeological Preservation Research Laboratory consistently yields waterlogged rope specimens that are aesthetically pleasing and dimensionally stable.

Accelerate aging tests and data supplied by Dow Corning Corporation continue to be encouraging regarding the long-term stability of silicone oil-treated artifacts. Eight silicone oil-treated samples were subjected to an extended test in an Accelerated Weathering Machine. The samples were exposed to four months of continuous alternating cycles of six hours at high humidity (95 percent) and high temperature (45°C) with a UV 340 light, and six hours at a lower humidity (60 percent) and temperature (20°C) with no light exposure. The tested sample data (including overall dimensions, color, and surface integrity) was comparable to data for silicone oil-treated specimens that had not undergone accelerated weathering.

There is no doubt that silicone oil treatments, like treatments that require applications of polyurethane in ethylacetate, are not reversible; this is not to say, however, that rope treated with silicone oil cannot be re-treated. In the past, Texas A&M conservators have re-treated several fragile leather and canvas artifacts preserved with lower centistoke silicone oils, using more viscous poly-

mers to add additional strength and stability. More importantly, waterlogged rope appears to respond well to treatment using silicone oils. While the authors do not suggest that silicone oil processes are a panacea for all archaeological conservation issues, they suggest that the field of archaeological conservation can benefit from ongoing research into silicone oil-treatment techniques. Based on experimentation to date, the authors would concur with Baltizar's observations that silicone oil preservation is a very promising technique for the consolidation and preservation of many waterlogged materials (Baltizar 1996). The added strength and elasticity characteristics associated with the silicone oil process used for this experiment may have important implications for the structural well being of some artifacts. Continuing research at the Archaeological Preservation Research Laboratory is focused upon these issues.

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Preliminary Report on the 1998 Excavations of the 1824 Wreck of The Royal Hawaiian Yacht *Ha'aheo o Hawai'i* (ex-*Cleopatra's Barge*)

Introduction

Built at Salem, Massachusetts, in 1816 by Retire Becket for George Crowninshield, Jr., *Cleopatra's Barge* was the first ocean-going yacht constructed in the United States. A few months after returning from a single six-month "voyage of pleasure" to the Mediterranean, Crowninshield died and the famous hermaphrodite brig was auctioned for $15,400 in August 1818. Purchased shortly thereafter by the Boston China traders Bryant & Sturgis, the luxury yacht sailed out to the Sandwich Islands in 1820 under co-owner Captain John Suter. Within a day of its Hawaiian landfall, Hawaiian King Kamehameha II (Liholiho) was aboard, and he purchased it nine days later for $80,000 worth of sandalwood (Crowninshield 1913; Whitehill 1959; Ferguson 1976). Renamed *Ha'aheo o Hawai'i* (*Pride of Hawaii*), the ship was the king's favorite possession.

In November 1823, Liholiho left Hawaii for England aboard an English whaler; both he and his queen died in London in July 1824. Unbeknownst to the king, a few months earlier his prized possession went for a cruise around Hawaii, and on 5 April *Ha'aheo* struck an onshore reef in Hanalei Bay, Kauai, and sank. The wreck site was located in July 1995 by the Smithsonian Institution's National Museum of American History (NMAH), and excavations have continued annually since then (Johnston 1996, 1997, 1998).

The 1998 Excavations

In-water activities began on 5 July 1998 with the placement of moorings for the research vessel and marker buoys along the adjacent reef perimeter and at the wreck site. Diving and excavations began on 6 July and ended on 1 August 1998. During this period, the team of five divers logged a total of 177 hours of bottom time in the southwest corner of Hanalei Bay excavating, recording, photographing, and backfilling the wreck site.

The 1998 excavations began by opening a trench (E15) on the wreck site adjacent to the border reef. As in prior seasons, the principal excavation tool was a propeller-wash deflector; a water dredge was applied briefly in trench E26 (also near the border reef) with less efficient results due to the depth of the sand overburden and consequent slump. Aside from these two trenches, the remaining 10 permitted trenches were set around the bayside perimeter of the wreck site in (relatively) deeper water, in order to define the boundaries more closely and investigate unexcavated areas.

1998 Findings

The 1998 finds generally parallel those from earlier seasons, with a few notable exceptions. Since excavations were principally limited to the outer perimeter of the wreck site, far fewer copper hull fasteners were recovered in 1998; this confirms historical accounts and earlier archaeological finds indicating that the vessel struck the reef below the waterline and sank more-or-less in place after an unsuccessful attempt to recover and refloat the hull. Further confirming this hypothesis, far larger quantities of iron-based concretions were found (241) in the 1998 outer trenches than in past seasons, and a considerable majority of them represent iron hull fasteners from above the ship's waterline. Within the ce-

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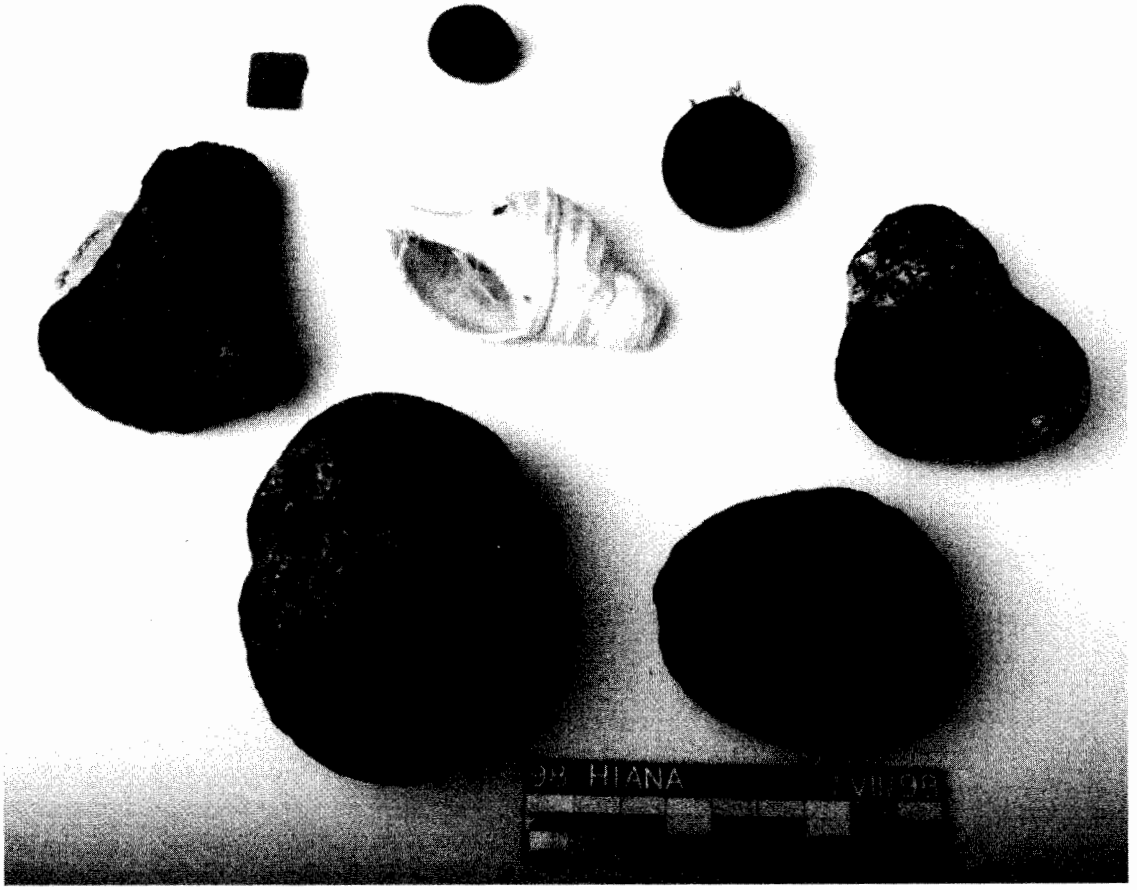

FIGURE 1. 1998 Hawaiian artifacts from the wreck include poi pounders (center left and right); game stones (top center and right); an unidentified worked stone (top left); small craft anchors or octopus lures (bottom) and a *pu*, or conch horn (center). (Smithsonian photo by Richard Strauss.)

ramic category, fewer examples were found than in prior seasons and nearly all post-date the shipwreck, but a higher proportion comprised intact and fragmentary bricks. 1998 highlights include a sizable group of Hawaiian artifacts that relate to food preparation, leisure activity, hand tools, ship equipment, and possibly even navigation.

Organics

Only two wooden artifacts were recovered in the 1998 campaign. One is a well-preserved cylindrical wooden pin measuring 11 1/2 in. long x 2 1/2 in. (shaft) diameter with a 3 1/2-in. diameter head pierced by a 1/2-in. round hole (W52); the absence of teredo damage and excellent condition of this specimen indicate that it is a hardwood (possibly lignum vitae). The other appears to be the body of a small, unpainted modern fishing lure with two small lead weights in one side for neutral/negative buoyancy (W53).

In the miscellaneous category, three sea shells were recovered. Two may be pearl oyster shells (MISC72) not indigenous to the Hawaiian Islands (Charles Blay 1998, pers. comm.); the other is a small, intact conch horn (MISC70), or *pu*, com-

plete with tonal hole (Figure 1), measuring 6 in. high x 3 1/4 in. wide. Two kukui nuts (MISC73) were raised in the 1998 season that originally may have been associated with the lava kukui nut oil lamp recovered in 1997 (MISC30; Johnston 1998:100). A total of 28 examples of bone were cataloged; these have yet to be analyzed in detail.

The fragmentary remains of a small keg of gunpowder also were located in 1998, consisting of the cask head or base and most of the contents (MISC58). Staves, hoops, and the other end of the cask were not found. Measuring 5 3/4 in. in diameter and 3/8 in. thick, the wooden head was recovered in two pieces; the contents were recovered in one solid lump that subsequently dissolved into several large pieces during desalination. The gunpowder is no longer flammable, indicating that at least one of the three major components of the substance has dissolved since the wrecking event.

Inorganics

Many of the 1998 lead finds resemble those from prior seasons: highlights include two musket balls; a few very long, thin lead scraps; a small, round lead "bun" ingot (L25) measuring 3 1/2 in. in diameter x 3/8 in. thick (possibly raw material for casting musket balls); and a slightly bent cannon apron (L19) or touch hole cover (Figure 2).

All but one of the 14 copper finds are hull-related (see below); the exception is a cylindrical copper pin or rigger's fid with an eye at one end (C54); the other end is flattened (Horsley 1978:183, Figure 70a, c). Measuring 9 in. long, the pin's diameter swells at the approximate midpoint to fit into a rail or fid block, and the upper, wider end tapers slightly to the flattened eye.

Most of the 107 glass lots recovered in 1998 postdate the wreck, with a few exceptions: one is several fragments of early-19th century case gin bottles (G70, 79, 85, 88, 105-107, 111, 121, 128, 131-132, 155) from several trenches (Figure 3). These finds, in combination with other, earlier fragmentary case gin bottle sherds, bolster the assertion of missionary Hiram Bingham, who visited Hanalei a few days after the wrecking, that the consumption of alcoholic beverages was a factor in the famous ship's loss (Whitehill 1959:12-13). A clustering of fragmentary mid-19th century alcoholic beverage containers probably dates to the 1857 salvage of the wreck by Hanalei resident A. S. Nuuanu (Johnston 1996:62), and another late-19th century cluster associated with the consumption of considerable quantities of alcoholic beverages also was recovered. Modern glass beverage containers—mostly alcoholic—also were well-represented among the 1998 finds. A single fragment of early window pane glass was found (G78), and three lots of glass from lamp or lantern globes also were recorded (G52, 59, 100); hopefully, further research will date these objects to the period of the wreck.

FIGURE 3. Lead cannon apron or touch hole cover (L19), measuring 8 1/4 in. long x 7 1/4 in. wide x 1/8 in. thick. (Smithsonian photo by Richard Strauss.)

FIGURE 3. Sampling of case gin bottle fragments from the 1998 season. (Smithsonian photo by Richard Strauss.)

A total of 48 lots of fragmentary ceramic sherds was recovered in 1998; nearly all reflect earlier season's finds of variously-dated stonewares, whitewares, and porcelains. An exception was a large quantity of 17 different colored intact and partial bricks, including one with a uniform dark gray, friable matrix that may be a whetstone (CER51). Along with the bricks from earlier seasons, these may reflect either the cookstove lining or possibly ballast. A fragmentary teacup marked on its base ". . .IAN/CHINA/ henngother/Sela/BAVARIA" also had the name *Haleakala* engraved in red on its base; this probably was deposited in the bay in 1925, when the cruise ship of that name made its only voyage to Kauai (Thomas 1983:166).

Aside from a growing collection of non-Hawaiian ballast stones from the site, other 1998 lithics comprised a sizable collection of Hawaiian artifacts, including what are tentatively identified as a lava anchor (MISC69); another lava anchor (MISC63) or octopus lure (Hans Van Tilburg 1998, pers. comm.); a lava anchor or canoe breaker (MISC77); two lava game stones, one of

which is an *ulu maika* (MISC75 and MISC65, respectively); two lava poi pounders (MISC66-67); and a small, wedge-shaped stone (basalt?) with grooves on both long sides (MISC64) (Figure 1). Combined with similar organic and inorganic Hawaiian finds from this and earlier seasons, these local artifacts are beginning to offer considerable insight into contemporary shipboard food gathering and preparation, ship and small craft operation, and leisure activity.

One unexpected discovery attests to the dynamic littoral environment in which the wreck lies. In the edge of one of the 1998 perimeter site trenches (several hundred feet offshore) was found a heavy, rectilinear concrete column with an "X" cast into one end, measuring 30 in. long x 4 1/4 in. on the sides (MISC78). Local surveyors in Hanalei identified this as one of several concrete property markers set along the shore of Hanalei and the Waioli River in 1920. It probably was moved offshore by one of the two tsunamis that struck Kauai's North Shore in the 1940s and 1950s (Wagner Engineering Services 1998, pers. comm.).

Although the 241 concretions recovered in 1998 have not been x-rayed or analyzed to date, one of the smaller examples may contain a bodkin or hat pin apparently made of silver (CON419).

Hull Structure and Rigging

Very few hull timbers were found, and those were fragmentary and poorly preserved due to teredo and environmental degradation. When found, they were measured in from benchmarks established along the reef perimeter in prior seasons. These measurements were then plotted,

FIGURE 4. Concreted upper pump valve complete with flappers or claques. (Smithsonian photo by Richard Strauss.)

and the timbers sketched by the divers. In some cases, smaller timbers were recorded in situ and then moved to the sides of their trenches, where all sides and edges could be measured, recorded, and photographed. In a few instances, small hull timbers were recorded in situ and raised for more detailed measurement and photography on the work deck of R/V *Pilialoha*. After recording, all loose hull timbers were redeposited into trench E28 for future research and/or recovery.

As mentioned above, nearly all of the 241 concretions recovered in 1998 appear to be iron fasteners. Two copper drifts also were raised, including an intact example (C59) originally measuring 2 ft. long x 3/4 in. in diameter, and a similar fragmentary example (C55). Intact and fragmentary square-headed, chisel-pointed copper spikes (C50-53, 56, 58) were represented, along with 13 hull sheathing nails in varying degrees of preservation. In 1995, a well-preserved corner fragment of copper hull sheathing with an inscription was recovered (Johnston 1996:64); in 1998 another inscribed corner fragment (HS45) was raised, but in far worse condition. Stamped ". . .L . . . SA. . ./4 C," this thin piece disintegrated during desalination (but fortunately after photography). Also recovered among the 43 lots of copper sheathing was the project's first complete piece (HS75), and another piece that may be intact but is too bent and crumpled to be certain at this writing (HS76).

In addition to the lead artifacts outlined above, several other pieces of lead were recovered from the ship's structure. Foremost among these are two more bent and crumpled but intact draft marks (L18, 30), paralleling the 1997 find of an "X" (Johnston 1998:101, Figure 4). Respectively representing an "IX" (or "XI") and "VI," these marks with multiple roman numerals cast in one piece clearly indicate that the draft mark "X" (L15) from last season is a "10," rather than a lower/higher number cast in multiple pieces. Together, these marks closely resemble similar examples from the suspected 1718 wreck of the pirate Blackbeard's flagship *Queen Anne's Revenge* (Lusardi, this volume) and the 1761 wreck of *Auguste* in Canada (National Historic Sites/ National Park Service 1992:56). Four more sections of lead plumbing pipe resembling earlier finds also were recovered; two of them display both horizontal and longitudinal seams indicative of the manufacturing process (L17, 21).

Numerous lead scraps of varying size, thickness, and condition have been raised over the past several seasons; these are believed to be raw material for hull or deck patches, or possibly for casting musket balls. In 1998, a large, thick, heavy lead patch was recovered for the first time, characterized by a uniform thickness and heavy fastener holes along three edges (L29) with an even larger fastener hole in the approximate center; the fourth edge is straight but lacks any holes along its length. This latter feature may indicate that it was not finished or applied prior to the loss of the ship.

Perhaps the most unusual hull-related find was the intact upper valve of an iron bilge pump (MISC56) measuring 12 in. long and with a head diameter of 4 1/2 in., with a two-part flapper or claque (Figure 4). Lightly concreted on all surfaces, it may have remains of leather sealing material around the valve claques (Thomas Oertling 1999, pers. comm.). Neither the lower valve nor the pump tube/sleeve were located. Some elements of rigging also were raised during the 1998 season, including such items as thimbles (MISC68, CON299-300) and two fragmentary pieces of leather chafing gear, complete with stitch holes but lacking thread (MISC60-61). Concreted iron hooks (CON214, 230); an iron ring (CON239); chain segments (CON250, 270); iron eyes, and eyebolts (CON244, 271, 311) also may fall into this category.

Related Research

Over the winter of 1997-1998, a sizable body of manuscript material relating to Captain John Suter was located at the Massachusetts Historical Society in Boston. Not only master of *Cleopatra's Barge* during its voyage out to the Sandwich Islands in June 1820, Suter was also a

partner in its ownership with Bryant & Sturgis, who sent the famous yacht out to the Pacific for Hawaiian King Liholiho's consideration. The collection ranges in date from 1804-1848; the material referencing *Cleopatra's Barge* covers the period from 20 June 1820 to 30 September 1821, and consists principally of correspondence between Suter and Bryant & Sturgis on the subject of the anticipated sale of the *Barge* upon its arrival in Hawaii. These papers make it clear that even before the famous yacht left for the Pacific, its owners believed that King Liholiho would be interested in its purchase. Suter was enjoined to sell the *Barge* as quickly as possible, then load the Bryant & Sturgis ship *Tartar* with the sandalwood proceeds from the sale and immediately sail for Canton to sell the cargo there. Failing a prompt sale to Liholiho, Suter was to either try to sell the *Barge* to King Tomaree of Atooi (Kauai), who was rumored to have a large stockpile of sandalwood, or take both the *Barge* and *Tartar* to the Pacific Northwest to engage in the fur trade. He was further urged to provide supplies and labor for any repairs that might be necessary to the Hawaiian King's growing fleet of western ships, and his Boston partners frequently reminded him to keep good records of all financial transactions. John Rives, the elusive French agent of the King who figured so prominently in the 1823-1824 voyage of Liholiho and his Royal party to England, also appears briefly in this manuscript collection through the purchase of cargo from the *Barge* shortly after its arrival at Oahu in December 1820. An undated (draft?) bill of sale for *Cleopatra's Barge* in the amount of 8,000 piculs of sandalwood also is among these papers, as is a similar document selling the Salem-built brig *Becket* to the King of Kauai for 3,400 piculs of "strait, merchantable" sandalwood. Like the *Barge*, *Becket* was built by Salem shipbuilder Retire Becket, after whom it was named. Quarrels with the Royals over the payment schedule and quality of sandalwood also are discussed in considerable detail, shedding light on the difficulties of conducting business in faraway places (Massachusetts Historical Society 1820, 1821). Together with the Bryant & Sturgis papers in the Baker Library at Harvard University, these manuscript materials offer considerable historical background on the career of *Ha'aheo o Hawaii* (ex-*Cleopatra's Barge*) in Hawaiian waters.

Conclusions

The 1998 excavations in Hanalei Bay, Kauai, consisted principally of trenches placed around the bayside perimeter of the wreck site, and the material excavated differed in part from that of previous seasons both in type and quantity. Further archival and artifact research is required, and as a consequence a study season will be conducted in 1999 instead of excavations in order to catch up on research. Excavations are planned to resume in 2000.

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and fortuitous events during the site formation process. Cloth was preserved because animal fibers (wool and, possibly, silk) were covered with birch tar that formed a protective coating over the bottom elements of the hull. The concreted sand/tar/iron conglomerate was so dense that hammering was necessary to free artifacts from the matrix.

The artifact assemblage suggests that the vessel's living quarters were preserved to an unusual extant. A camboose (ship's stove) was found as well as bottles, ceramics, and utensils. What might be a portion of the cargo is represented by some 140 shoe buckles, iron bars, and iron plates. It is possible some of these iron artifacts are ballast.

Colliers

Colliers were bulk carriers, typically involved in the English coastal, North Atlantic, and Baltic trades. They were frequently chartered to the Royal Navy as troop, equipment, and supply transports (Syrett 1970:61-106). As a class of vessel, they were of moderate size, well-built, with a shallow draft. Construction features observed on archaeological sites suggest the framing was fairly heavy. Three colliers have been investigated archaeologically to date, the *Betsy* at Yorktown, an unidentified vessel off Bermuda, and *The General Carleton of Whitby*.

The Yorktown collier, probably the *Betsy*, was sunk in 1781 and investigated during the 1980s. Identification as a collier was made possible by a variety of non-structural elements, such as barrel heads with the master's initials, as well as heavy construction and tightly fitted bilge ceiling for bulk cargoes (Morris 1991; Morris et al. 1995).

A Bermuda wreck site investigated during 1992 and 1993 contained lower hull elements with a striking similarity to the *Betsy*. The site's interpretation as a collier was based on framing pattern and scantlings among other elements. Identification as a collier was aided by the presence of considerable amounts of coal residue in the bilge (Watts and Krivor 1995; Krivor 1998).

General Carleton of Whitby

A ship's bell identified the W-32 vessel. Lloyds Register of Ships reports that the *General Carleton of Whitby* was built in Whitby, England, in 1777. Whitby was very heavily involved in the Baltic trade during the 18th century. In 1792, there were over 50,000 tons of shipping registered as owned in Whitby, making it Britain's sixth largest ship-owning port (Johansen 1983, Table 2.3; Ossowski 1996:32-33).

The *General Carleton of Whitby* was designed to carry coal between the Tyne and Thames rivers with a second possibility of engaging in the lucrative Baltic trade. The ship was built before compulsory vessel registration began in 1786 so precise dimensions and tonnage are unknown. *General Carleton* was owned by N. Campion and captained by T. Pynam. The maiden voyage was to the Baltic port of Riga. Mrs. Margaret Campion, a freeman of the Russia Company, which controlled all British trade in the Baltic, managed the ship (Ossowski 1996:33).

By 1782, Lloyds' register noted several important changes: the vessel had been sheathed and ten 6-pounder cannon were added. The new master was W. Hustler. The armament was increased when *General Carleton* was leased to the Navy Board as a transport. As a hired vessel, the *General Carleton* crew was protected from press gangs. A tin box recovered in 1995 contained an incomplete document granting "protection" from impressment for the vessel's crewmen (Ossowski 1996:33).

At the time of the sinking, the master, William Hustler, had a mate, cook, carpenter, an unidentified number of sailors, and fourteen servants. These "servants" were young boys learning seamanship. The last ship's muster roll shows that the vessel was lost on 27 September 1785.

One unique artifact and a single artifact class will be discussed here, both because of their rar-

FIGURE 1. Stockings from the *General Carleton of Whitby.*

ity. It is not our intention to discuss stabilization and on-going conservation. The first is the ship's stove, or camboose.

Camboose

The camboose is a ship's stove. The *General Carleton*'s stove is made of 3/8 in. (10 mm) iron sheeting. It measures approximately 30 x 30 x 24 in. Only two other contemporary stoves are known. One was found on the HMS *Pandora* (sunk 1791); the other was thrown overboard as of no value by the salvors who raped HMS *De Braak* (sunk 1798) (Shomette 1993:20, 221). Another ship's stove was recovered from the Rose Hill Wreck, a civilian vessel dated between 1725 and 1750 (Wilde-Ramsing et al. 1992:49-52, 77). The Rose Hill ship's stove is different from the camboose reported here. Research is underway to determine if the *General Carleton*'s camboose is a Brodie Patent Stove similar to those found on the other British warships.

Clothing

The most spectacular class of items found on the *General Carleton* is the sailor clothing. Most clothing found on the *General Carleton* seems to fit that generalized class of sailor's clothing called "slops." These were items of clothing purchased by the ship's purser or steward for issue and/or sale to the crew. Slops could be issued when a man was pressed and without proper clothing or when their personal clothing wore out (Mountaine 1783:71-73, 190; Lavery 1989:204). Very little is known about slops beyond written references and no complete sets were known until this find. The *General Carleton*'s clothing was not unissued as repairs were noted on some items. Some button holes were distorted indicating that they had been worn and stretched. Thus, this clothing represents items actually worn by British sailors during the era of the American Revolution.

Sailors, as a class, had a very distinctive dress, called "short clothes," to distinguish them from landsmen who wore long coat, breeches, stockings, and overalls. Sailor clothing was imminently functional in that it provided wide openings for legs and arms, could be rolled up, and the jackets lacked entangling tails. These attributes were ideal for a seaman who needed great flexibility in his arms and legs when climbing and stepping onto ropes and yards. The ease with which breeches and trouser passed over the lower thigh and upper calf was essential to avoid tearing the cloth or splitting the seams (Lavery 1989:204; Babits 1996).

Thirty shoes were recovered. Some were partially disarticulated due to disintegrated thread. An additional 30 shoe fragments also were recovered. Analysis of the shoes is still underway but they seem typical of the late-18th century. One boot and the upper from a second boot were also found.

Thirty-two stockings were recovered (Figure 1). These were both knitted wool and sewn cloth. Some of the sewn cloth stockings had reinforced

FIGURE 2. Breeches (rear) from the *General Carleton of Whitby.*

tops and toes. With one exception all were plain. The one exception was a knitted wool stocking with a ribbed upper. None exhibited clocking (Klinger and Wilder 1967:27; Baumgarten 1986:48), although some did have gussets at the ankles. While sailors of the late-18th century were often described as having striped stockings; no striped examples were found on the *General Carleton.*

Parts of at least three pair of breeches were found (Figure 2). These were made of, as yet, undetermined woolen fabrics. Analysis is still underway but the quality varied from fairly fine, though thick, fabric to rather coarse cloth resembling modern burlap. It is possible that the coarser materials were worn as outer garments to protect finer clothing.

The remains of three shirt sleeves were recovered. One sleeve with cuff appeared to be cotton or fine linen and its preservation was most unusual in that it was made of vegetable fiber that does not survive well in an underwater environment. It had a button cuff. The other two sleeves were not inspected.

Waistcoats, or vests, are represented by two examples. One is white wool; the other a light colored wool. The first vest is damaged on the upper part and the back is missing. It is double breasted, cut straight across the bottom front, and had welted pockets set into both front panels. Originally, this vest had two rows of eight buttons. It survived with eight, 14 mm, two-hole, cloth-covered wooden buttons still attached. On the left front panel, the third button from the bottom is at the top of the pocket welt. The front panels have a 16 cm wide inner facing composed of the same material as the vest body extending to the top of the pocket opening. It originally probably extended to the bottom of the vest as indicated by a line of stitching on the bottom right front panel.

The second vest is fragmentary, consisting of a single breasted, left front panel with an inserted pocket. This example was pierced for seven buttons. This vest had a 10.5 cm wide inner facing for the front panel. The line of stitching

FIGURE 3. Jacket from the *General Carleton of Whitby*.

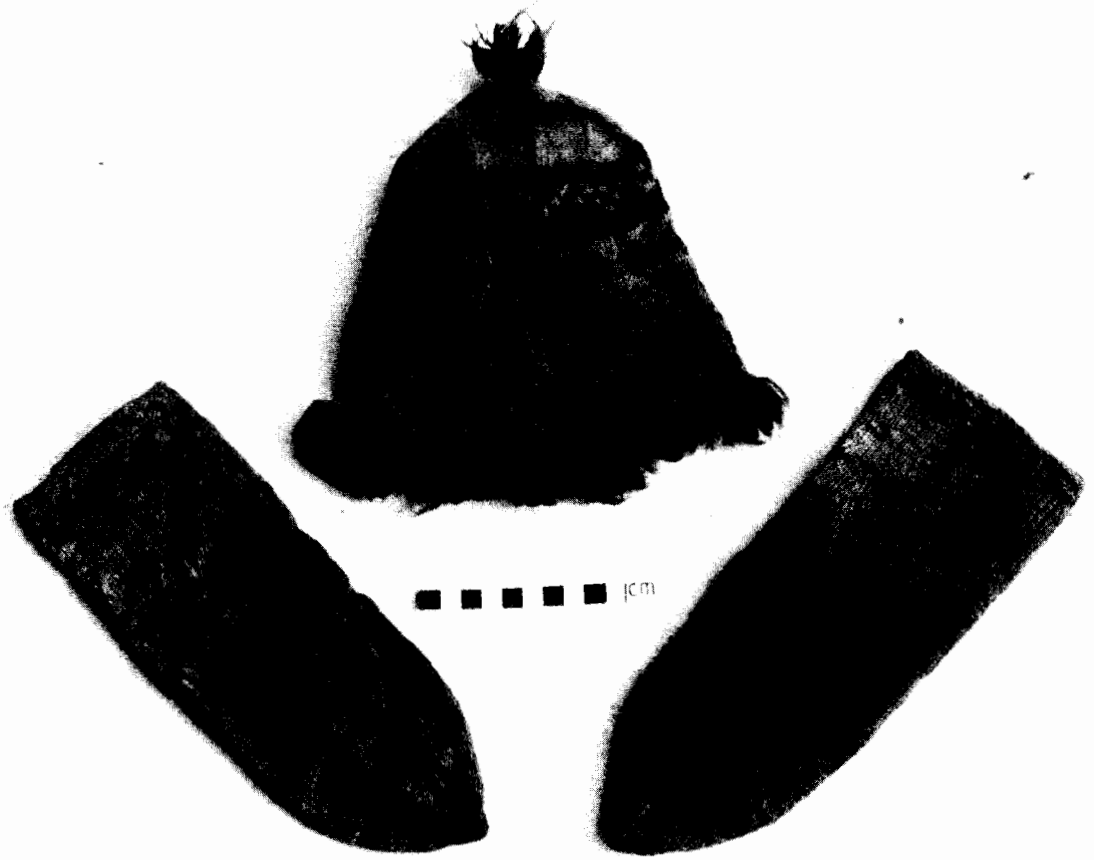

FIGURE 4. Monmouth Cap and Mittens from the *General Carleton of Whitby*.

holes goes completely around the panel and is also found around the arm hole indicating this is a vest, rather than a jacket. The lower rear portion of the panel has a slight "tail," to go under the extended rear panel tail (Klinger and Wilder 1967:7-8).

Both vests almost certainly had linings. This conclusion is drawn from the manner in which the bottom edge is turned up and from the missing pocket bags. It is likely the lining and pocket bags were linen or cotton and did not survive.

At least three woolen jackets were recovered (Figure 3). These were present in both single and double breasted form. There were no linings present but stitching and folding of the outer fabric indicates linings were once present. Typical linings were cotton or linen; it is likely that these coats had the cheaper linen linings. Both jackets were made of heavy wool fabric resembling broadcloth.

The double breasted jacket had welted pockets cut into the front panels. The front panels had an interior facing of the same material as the

jacket body. The jacket was fastened by two rows of eight buttons. The sleeve had slashed cuffs, closed by a flap and three buttons. Many cloth covered buttons were still attached to this jacket. The front panel buttons were approximately 20 mm and the sleeve buttons were about 14 mm. The single breasted jacket is represented only by one sleeve, cuff, and front panel. It is very short in length and might even be termed a sleeved waistcoat rather than a jacket.

Forty-two unattached buttons were recovered. These loose buttons were a mixed lot. They are largely cloth covered wooden buttons although some pewter, leather, or bone examples survived. Analysis of the buttons is continuing. Based on button diameters and the length of the button holes, it is probable that some of the buttons were once fitted to the jackets or breeches.

Two types of headgear were recovered, knit caps and felt hats. The one knit cap was a tasseled and fringed monmouth cap (Figure 4) with horizontal bands of decoration on the body of the cap. The bands are darker in color and were probably blue or black against a white or natural wool body. Monmouth, or stocking caps, were popular with sailors all through the 18th and 19th centuries (Lavery 1989:204) and survive today as watch caps.

Three felt hats were recovered. Two were once cocked, judging from holes for cocking ribbon in both crown and brim. There was evidence for binding on the brim edge on one hat. There was no surviving lining although some stitch holes and the hat shape suggested they were once lined or hat sweat bands. This style hat can be seen in most late-18th century military images although styles were changing to the chapeau de bras (Klinger and Wilder 1967:1-2; Howell and Kloster 1969:1-5; Baumgarten 1986:65, 71). The third felt hat was a sailor's "high hat" or top hat. This example had extant binding on the brim edge and almost certainly had a cloth lining, based on the stitch holes seen at the base of the crown. Illustrations of this style hat can be seen in Lavery (1989:130, 133, 176, 179, 202). This hat on the *General Carleton* seems unusual as the style was more common during the 1790-1815 period than earlier.

The final clothing items were a pair of woolen mittens (Figure 4) and a single glove. The mittens were undecorated and undyed. The left handed glove was dyed a darker color, possibly blue or black, and had a fringe around the wrist as well as a second line of fringing about 1.5 in. from the wrist. The glove and mittens did not show any wear damage.

Conclusions

The excellent fabric preservation represents an incredibly important collection of common sailors's clothing dating to the late-18th century. What is presented here is preliminary in nature because stabilization, analysis, and conservation are still underway. Nevertheless, the value to our understanding of maritime clothing can already be seen because this clothing provides examples of used sailor attire previously seen only in illustrations.

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Do the Artifacts Identify the Beaufort Inlet Shipwreck as the Pirate Blackbeard's Flagship *Queen Anne's Revenge*?

Introduction

Beaufort Inlet Site 0003BUI was discovered in the fall of 1996 by the private research firm Intersal, Inc. Preliminary analysis of the site and its artifact assemblage has led researchers to tentatively identify the shipwreck as the pirate Blackbeard's flagship *Queen Anne's Revenge*, known to have been lost near the inlet in 1718. Archaeologists from the State of North Carolina, in cooperation with Intersal, Inc. and Maritime Research, Inc., completed a second five-week long field season in November 1998. This paper is a report of the most recent findings.

1997 Fieldwork

The October 1997 field season primarily consisted of a pre-disturbance survey and mapping of the exposed portions of the Beaufort Inlet wreck site. The results of the 1997 field season were reported by Wilde-Ramsing (1998). A site plan was compiled that included the main ballast pile, anchors, cannons, and exposed concretions. Several test units were excavated around the periphery of the ballast pile to evaluate the extent of the site, as well as to determine what types of artifacts may be encountered beneath the surrounding sand. Test units were also excavated over the north anchor stock to determine its condition and collect a wood sample and in the area of two cannons slated for recovery. A small

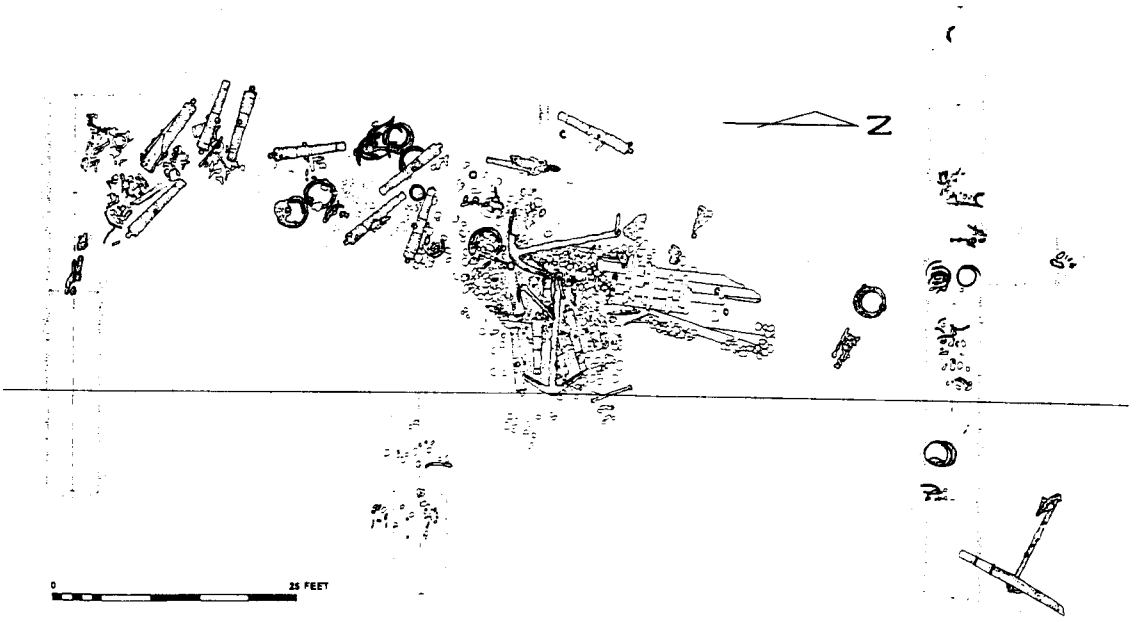

FIGURE 1. Beaufort Inlet wreck 0003BUI site plan at the completion of the 1998 field season. (Drawing by David D. Moore and Wayne R. Lusardi.)

Underwater Archaeology, 1999:123–132.

group of artifacts such as cannon shot, ballast stones, and barrel hoop concretions were recovered from the test units.

1998 Fieldwork

The 1998 field season in September and October was designed to continue assessment of the site and a means to further determine the extent of the artifact debris field. A new baseline was placed to the east of the main ballast pile aligned north-south, and three transects were excavated using airlifts and dredges (Figure 1). A trench at the north end of the site resulted in the discovery of additional ballast stones, barrel hoops, and miscellaneous encrusted artifacts. A second trench extended to the east of the main pile, and although some ballast and isolated artifacts were located, cultural materials quickly gave way to sterile sand. A third trench was excavated south of the main pile. Archaeologists also concentrated on a fourth area of the site where a large section of wooden hull structure was partially exposed through natural erosion. The structure consists of approximately 14 frame sets held together by four outer hull planks, some with sacrificial sheathing still underneath (Moore, this volume). The Beaufort Inlet site is very dynamic and shifting sands regularly bury or expose portions of the wreck. The hull structure was entirely buried in 1997 and was exposed the following year probably as a result of Hurricane Bonnie. Conversely, the southern portion of the site where the two cannons were raised in 1997 is now buried under 1 m of sand.

The Artifacts

Three hundred and ninety-five artifacts or groups of encrusted artifacts were recovered by archaeologists during the 1997 and 1998 field seasons. Many have not yet been conserved or x-rayed and therefore cannot be categorized. The majority of the ferrous artifacts so far recovered consist of hollow molds within the concretions, and the exact form of the original artifact will not be known until the casting process is completed. Several groups of artifacts are readily identifiable, however, and will be discussed below.

Arms

Two cannons located near the south end of the main ballast pile were brought to the surface in 1997. The French slaver *La Concorde de Nantes* was originally outfitted with 14 guns before Blackbeard captured it and renamed the ship *Queen Anne's Revenge*. Blackbeard is known to have increased the vessel's compliment to as many as 40 cannon, though contemporary accounts conflict on the exact number. According to the Bostock deposition (1717), for example, the *Queen Anne's Revenge* was mounted with 36 guns, while Thomas Knight's deposition (1717) reports 22 mounted guns. Walter Hamilton (n.d.) claims that "the ship say some has twenty two others say she has twenty six guns mounted but all agree that she can carry forty." All but one of the 18 cannon so far discovered on the site appear to be 6-pounders, weighing approximately one ton apiece, and 8 ft. in overall length. The guns so far recovered are of cast iron, and only one features any markings: crudely chiseled numbers 1, 7, 3 and possibly a 0 running lengthwise along the tube near the breech. The numbers likely represent the weight of the gun in hundred weights [17(112) + 3(28) = 1988 lbs.]. A third cannon was brought to the surface in 1998 and is considerably smaller than the others, measuring only 6 ft. in length. Hopes are that this gun contains diagnostic markings on the breech or trunnions. The cannon is heavily encrusted, however, and will require a lengthy conservation process to remove a large collection of artifacts, including ship rigging, ballast stones, ceramics, wood, iron fasteners, and other objects attached to it.

Artifacts associated with the cannon include iron round and bar shot, a lead cannon apron or touch hole cover, bag shot with shrapnel, and possible carriage hardware. Small arms from the

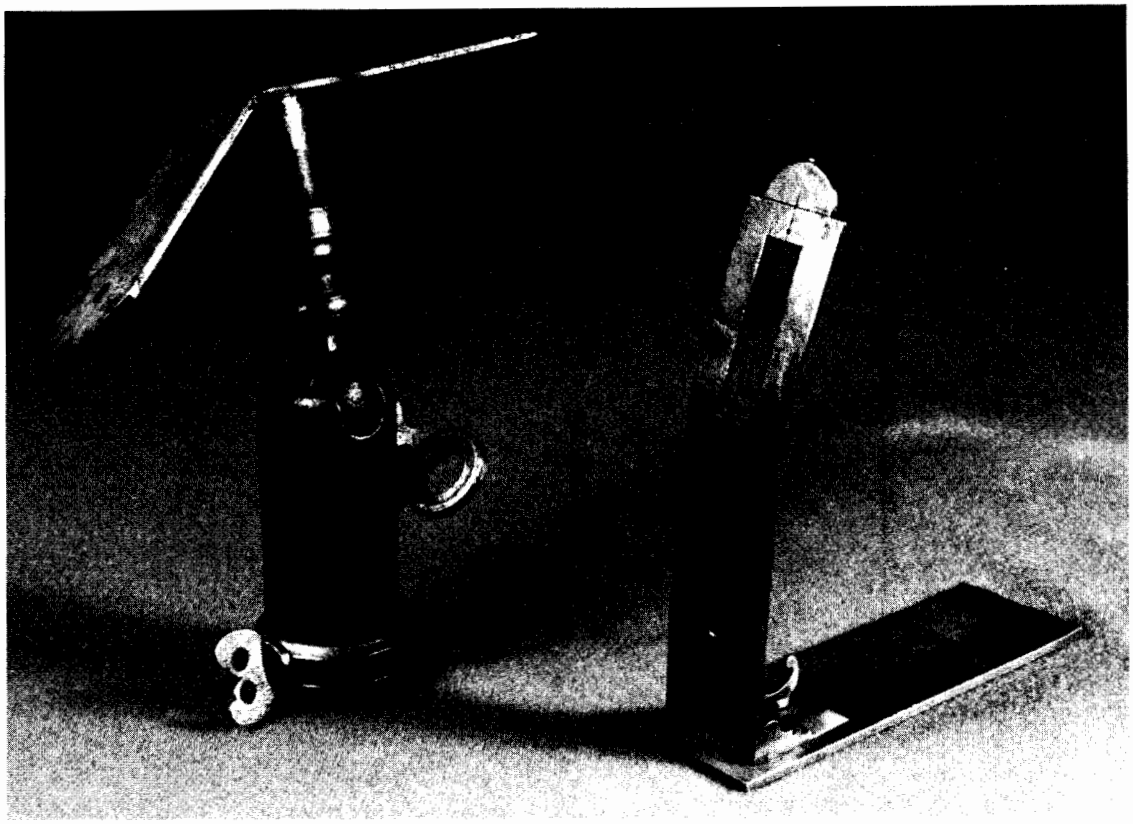

FIGURE 2. Left, Brass universal staff mount. Right, Surveying instrument sight.

site include a brass musketoon or blunderbuss barrel, and a wide variety of small caliber lead round shot. No edged weapons have yet been recovered.

Scientific Instruments

The majority of the artifacts recovered during the 1998 field season were found at the south end of the site in the 30-40 ft. test trench. Several scientific instruments were recovered, including a universal staff mount, probably used to affix a plane table, transit, circumferentor, or other similar surveying device to a tripod stand (Figure 2). The staff mount (16.5 cm in height) consists of a mounting plate and socket connected by a universal ball joint. A worm screw rotates an internal gear, which in turn exerts pressure on a leather gasket thus fixing the ball in place. Decorative set-screws also fix the mount in position. Pivotal mounts like this can be seen on a variety of instruments dating from the 17th and early-18th centuries. M. Bion, the Chief Instrument-Maker to the King of France in the early part of the 18th century, published a manuscript describing several surveying instruments that feature similar pivotal mounts (Bion 1995:Plates xii-xiv).

A brass sight for a surveying device was found 1 m from the pivotal mount, and the two pieces likely came from the same instrument (Figure 2). The sight (15 cm in height) is slotted twice for

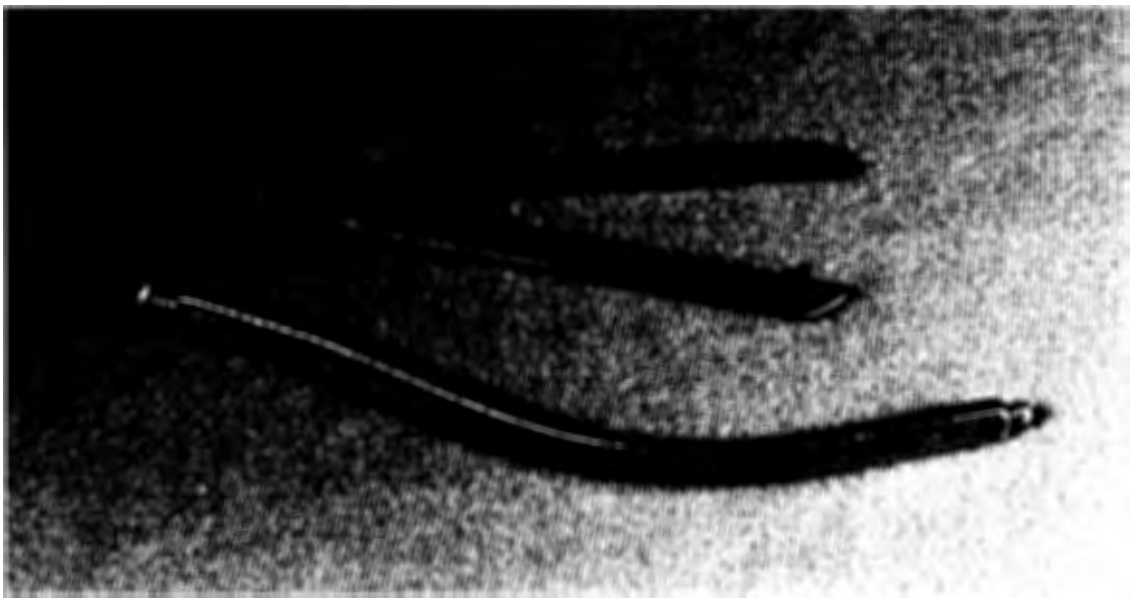

FIGURE 3. Top, Brass sector. Bottom, Logarithmic scale.

rough and pinpoint aiming, and the larger slot (4.5 x 1.1 cm) is bracketed by two holes that would have held a crosshair. A set-screw attaches the sight to an index that is broken at a threaded fastener hole. When intact, the index would have held a second sight with opposing slots. According to Bion, "There are also two Sights to screw on, or slide up and down the Index, like those belonging to the Index of the Plain-Table; as likewise a Spangle and Socket screw'd on to the back-side of the Circle, for putting the Head of the Staff in" (Bion 1995:128).

A brass sector (12.9 cm closed, 23.8 cm open) features two logarithmically scaled arms joined at a pivotal hinge (Figure 3). Although no numbers are present, recessed dots or needle holes in sets of two, three, or four bracket some of the line spaces. A line of English inches (2.54 cm) occurs on the inside edge of one arm, while the back edge when opened is divided evenly into eight French inches (2.75 cm); the first block of both scales is divided into 12 increments. A small set pin ensures that the arms line up when the instrument is closed. Although outwardly similar to gunner's calipers, the inside edges of the arms are not concave and therefore will not wrap around spherical shot. The instrument also resembles Thomas Hood's Sector (1598) and Edmund Gunter's Sector (1605-1606). When used with a pair of compasses, the sector enabled problems involving proportions to be solved instrumentally (Waters 1958:417). A similar sector with dots and without numbers was found on the British man-of-war *Maidstone*, lost in 1747 (de Maisonneuve 1992:21), and a Gunter's Sector is reported from the pirate vessel *Whydah Galley*, lost in 1717 off Cape Cod (Hamilton 1992:222).

Logarithmic scales also occur on three of the four faces of a brass bar (21.9 x 0.8 x 0.5 cm) surmounted by decorative finials on either end (Figure 3). The zero points are staggered, though all are numbered by fives; two from 0-24,

and the third from 0-60. The only identification mark is in the form of a 6-pointed star stamped near the end of the bar. Although outwardly resembling several known instruments, such as gunner's tally sticks and daggers used to calculate shot and bore diameters, and Gunter's Scale (1623), which compares the line of numbers (0-10), sine (0-90), and tangent (0-45), this artifact is not an exact match to any and may represent an altogether different instrument.

A flat, brass key-like object pierced at one end (3.6 cm in length) may prove to be an identification tag for a surveying chain. Surveying chains typically consisted of steel links 1 ft. in length, each fifth or tenth increment marked with a pin or tag held in place by a wire.

A rolled brass tube (17.2 cm in length, tapering from 0.9 to 0.5 cm in diameter) has so far avoided identification. A square brass rod was soldered to the tube along the seam, and although the identity or function of this object is unknown, it resembles a rough sight for a telescope or theodolite.

Navigational instruments from the Beaufort Inlet site include a set of dividers (10.5 cm) nearly identical to a pair recovered from the *Whydah* (Hamilton et al. 1992). A lead sounding weight (42.9 cm in length) engraved XXI (21 lbs.) was one of the first artifacts recovered from the site in 1996. Two smaller lead weights (14 and 19 oz.), both carved with a bladed tool, were found in 1998. Though similar to fishing weights, both of these artifacts feature hollowed out bottoms typical of most sounding weights and may well have been used to determine depth and bottom characteristics in shallow water. There is also the possibility that these weights were used as counter-balances for scales or plumb bobs for surveying instruments.

Blackbeard was known to have taken these sorts of scientific and navigational instruments off captured vessels. Henry Bostock (1717), for example, claims that in addition to food, arms and munitions, "Edward Tach . . . took from him . . . his books and instruments." All transatlantic vessels the size of the *Queen Anne's Revenge*

FIGURE 4. Pewter urethral syringe with stamped ring.

carried such instruments, however, and because no redundant items have yet been recovered, the presence of the instruments alone does not necessarily help to support the identity of the wreck

A urethral syringe (15.9 cm in length) with its curved funnel tip was used to administer mercury for the treatment of venereal diseases (Figure 4). Analysis of residual material recovered from the interior of the syringe shows a high concentration of mercury. In May 1718, not even a month before the wrecking of the *Queen Anne's Revenge*, Blackbeard laid siege to the city of Charleston, South Carolina. Instead of demanding a typical ransom, Blackbeard insisted on a chest of medicine which may have included instruments such as this syringe. Blackbeard also held captive three surgeons from the *Concorde*. According to Lt. Ernaut, the slaver's commanding officer, "the said pirates retained by force ten men of their crew, namely . . . Jean Dubois, Gascon, surgeon major; Marc Bourgneuf, second surgeon, from La Rochelle; Claude Deshayes, third surgeon . . ." (Ernaut 1717). It is likely that all of the surgeons would have had their instruments in their possession.

The ring on the plunger of the syringe features a mark consisting of the letter P below interlocked rings and a crown. A second mark is indecipherable but looks something like the letter P beneath two sets of columns and a crown. Although syringes are fairly common on shipwreck sites, identifying this mark may reveal a source for this artifact, which may in turn help to identify the wreck.

Pewterware

Four large pewter chargers (51.4 cm in diameter) and two smaller pewter plates (24.1 cm in diameter) have so far been recovered. Two additional plates remain attached to one of the cannon on the wreck site. One of the chargers features a set of four unofficial "hall marks" on the upper rim. Hallmarks identify the maker and were designed to imitate gold and silversmith marks to give an official appearance to pewterware (Kerfoot 1924:188-189). The monogram B.A.S. also occurs on the upper rim of the charger and may well identify the owner of the plate or the vessel to which it was assigned. A plate from the *Henrietta Marie*, for example, had HM stamped on its base (Mel Fisher Maritime Heritage Society [MFMHS] 1995:56), and another from the *Whydah Galley* featured the initials WG (Hamilton 1992:370). A search through the inventory of vessels captured by Blackbeard, along with the list of the ship officers, has not yet revealed a name matching the initials. The underside of the rim of the same charger features the word London bracketed by two circular marks, one identifying the maker, the other a London secondary guild mark. A smaller plate also features base marks including the word London, a London/Tudor Rose secondary mark, and the partial name of [GEO]RGE HAMM[OND], a flexed arm wielding a sword. Hammond's mark also occurs on a plate recovered during the 1997 field season, and from several basins recovered from the British slaver *Henrietta Marie*, lost in the Florida Keys in 1700 (MFMHS 1995:56). Hammond is known to have worked in London from as early as 1693 and was made steward of the Worshipful Company of Pewterers in 1709 (Cotterell 1985:225). It is unknown how long his career extended beyond 1709.

According to the Bostock Deposition (1717), "He saw a great deal of plate on board of them tanka[rds?] cups & Ca." The pewter occurring on the Beaufort Inlet shipwreck may have been left over trade items destined for the African market, like the pewter on the *Henrietta Marie*. Two of the chargers, for example, contain the impressions of fabric on their surfaces, suggesting they were in storage when the ship sank. Cut marks on other plates, however, indicate the possible utilization of the wares by the ship's crews.

Glassware

Two intact green glass onion bottles were found adjacent to one another between two can-

non. Several additional necks and bases from similar wine bottles have also been recovered, along with fragments of square green glass case gin bottles. When compared to Noël Hume's Colonial Williamsburg typology, the wine bottles most nearly match those dated to 1710 (Noël Hume 1982:64).

Ceramics

The ceramic assemblage from the Beaufort Inlet site so far includes a single rim shard of tin-glazed, red-bodied Faience; five pieces of salt-glazed stoneware; and several fragments of a very large red earthenware oil jar(s) including a rim shard, base piece, and a half-oval handle fragment. When intact, the jar would have resembled several recovered from Colonial Virginia that date to the early-18th century (Noël Hume 1982:143).

Gold Dust

Some of the best circumstantial evidence to help support the identification of the Beaufort Inlet site as being the *Queen Anne's Revenge* comes from the smallest of the artifacts so far recovered. Approximately 70 flakes of gold in its natural form were found in a concentrated area intermixed in a field of lead shot and sand. Combined, the gold weighs just under 2 grams. Although valuables were not expected to be found on the wreck because of the circumstances of its sinking (i.e. it did not sink in a catastrophic event, rather was abandoned with time to unload valuables), several historical accounts place gold dust on board the *Concorde*. According to Lt. Ernaut, for example, in addition to the 516 slaves loaded on board the slaver on 8 July 1717 at Judas, "fourteen ounces of gold in powder" was taken aboard in West Africa (Ernaut 1717). When overtaken by Blackbeard near the Caribbean island of Martinique on 28 November 1717, a chamber boy belonging to the *Concorde*'s crew revealed the presence of gold when he "declared to the said pirates that his Captain and officers had some gold powder, and seeing that the said pirates threatened the aforesaid and the crew to cut their throat if they did not give up the gold powder . . ." (Ernaut 1717). The crew promptly surrendered the gold dust to the pirates, and the chamber boy quickly volunteered to join Blackbeard's crew.

Pierre Dosset, Master of the *Concorde,* also gave a detailed description of the quantity of gold dust taken by the pirates from the slavers:

> said that he gave the order to Charles Baudieu, his second on the said ship to take five pounds of gold powder from Mr. Turgot, lieutenant on the ship *The Ruby* from St. Malo, which gold the said Baudieu has placed in the hands of the informant and which said gold powder was taken and plundered by the pirates together with thirteen pounds and six ounces, belonging half in half to MM. Dosset, Martin and friends, and furthermore fourteen ounces belonging to the cargo of the said ship, and furthermore eight ounces belonging to Pierre Sagory, second pilot, plus 3 ounces belonging to M. Moret, captain of marine for 3 ounces of brandy that he had entrusted to him, plus two ounces belonging to Pierre Favier, first ensign on the said ship . . . (Dosset 1718).

Altogether, 20 lbs. 1 oz. of West African gold dust was reported stolen by Blackbeard from the officers and crew of the *Concorde*.

Henry Bostock, master of the sloop *Margaret* captured by Blackbeard on 5 December 1717 near Crab Island, also refers to gold dust on board the pirate vessel. According to Bostock, "This deponent further saith that among other riches he believed they had much gold dust on board" (Bostock 1717).

Ten flakes of the gold recovered from the Beaufort Inlet shipwreck have been analyzed by geologists from La Que Corrosion Services and VPI-Blacksburg, Virginia. The interiors of eight of the pieces are between 65 percent and 91 percent pure gold, while the exteriors feature a high purity gold rim, nearly 100 percent gold. This differential layering of gold is typical of grains found in stream placer deposits. The interior impurities usually consist of silver, with traces of mercury. A natural gold crystal was also found on the site, and gold in this form

indicates recovery close to its source area. Gold of this size and shape does not occur naturally off the coast of North Carolina, and trace elements such as iridium may help to identify its original source.

Miscellaneous Finds

About a dozen decorative lead tacks (2.5 cm) were found in the south trench. The shanks are square in section and taper to a point, while the heads are decorated with a rosette or flower with a central boss. The tacks, too soft to be hammered, were likely used to decorate upholstery, furniture, leather lined boxes, or chests. Identical tacks are reported from the *Whydah Galley* (Hamilton 1992:397, Hamilton et al. 1992). Other miscellaneous artifacts include a kaolin pipe stem (8.9 cm in length, 0.28 cm bore diameter), a sandstone whetstone (10.5 x 3.8 x 1.4 cm), a brass sail needle, two lead draft markers, and several lead strips containing hair and pitch.

Additional Analyses

In addition to the excavation of test units and trenches and the recovery of diagnostic artifacts, a wide array of specimens were collected during the 1997 and 1998 field seasons. Radiocarbon samples from hull planks, frames, sacrificial planking, and anchor stocks, along with hair recovered from caulking and pitch, were collected and sent to the accelerator mass spectrometer facility at Woods Hole Oceanographic Institution at Cape Cod, Massachusetts. Wood samples were also identified by Dr. Lee Newsom at Southern Illinois University, and tree ring sections will be compared to the dendrochronology record in France where *La Concorde de Nantes* was originally built.

Geologists from the University of North Carolina (UNC)-Asheville and Appalachian State University sectioned ballast stone to determine rock type and possible source location. Basalt, andesite, diorite, granite, schist, quartz, conglomerates, and limestone have all been recovered, all of which are indigenous to France, West Africa, and particularly the Caribbean. The French Geologic Service will use age-dating to see if it is possible to match the ballast stones from the wreck with similar rocks from Nantes.

Radioisotopes including Cesium 137 and Plutonium 239 and 240 created from atmospheric nuclear testing in the 1950s have accumulated in most marine sediments worldwide, and geologists should be able to determine if the sediments collected from beneath the ballast stones and hull structure contain these elements. If bomb-produced radioisotopes are detected, it could indicate that the site is more dynamic as a result of storm impacts or burrowing organisms and that the artifacts have shifted about the sea floor in the last 50 years.

The Institute of Marine Sciences at UNC Chapel Hill stationed an Inter-Oceans S-4, electromagnetic current meter and wave sensor near the site in the spring of 1998. The instrument survived Hurricane Bonnie and continues to provide valuable details of storms, waves, tides, and current speed and direction that adversely effect the site. Water samples were collected by scientists from the Marine Technology program at the Cape Fear Community College in order to determine redox potential, salinity, and pH to help conservators better treat the artifacts recovered from the site. Additionally, historians continue to search the archives for relevant documents that may help to identify the Beaufort Inlet shipwreck as Blackbeard's *Queen Anne's Revenge*.

Conclusion

Interesting parallels have come to light between the Beaufort Inlet shipwreck and both the *Whydah Galley* (1718) and the *Henrietta Marie* (1700). All three vessels, assuming the Beaufort Inlet wreck is indeed the *Queen Anne's Revenge*, were British or French slavers that traded in West Africa and the Caribbean. Two of these vessels, with the exception of the *Henrietta Marie*, were captured and ended their careers as pirate ships. The existing hull structures, ballast,

and ship elements such as rigging and anchors suggest vessels of the same relative size. Many of the same types of artifacts were recovered from each of the wrecks including arms, pewterwares, navigational instruments, and glassware. Although the identity of the Beaufort Inlet shipwreck cannot yet be positively established, project archaeologists are fairly confident that the vessel dates to the right time period based on its artifact assemblage. The site location also corresponds to historical accounts, and other vessels known to have wrecked in the area have been ruled out because none carried the 18 cannon already found on the site (Wilde-Ramsing 1998:58). Nothing found to date disputes the identity of the shipwreck, but further research, both in the laboratory and in the field, will be necessary to associate the Beaufort Inlet site with Blackbeard's *Queen Anne's Revenge*.

ACKNOWLEDGMENTS

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Introduction

On 26 August 1998, Hurricane Bonnie arrived off the eastern U.S. coast near Wilmington, North Carolina, as a category two storm (96-110 mph). Though the storm quickly downgraded to category one (74-95 mph) and then to tropical storm status as it made its way northward along the southeastern North Carolina coastline, the effects around the Beaufort Inlet vicinity were more like that of a substantial "northeaster" due to this duration. Winds at tropical storm velocity or greater were felt for over 60 hours prompting concern that site 0003BUI would be subjected to negative environmental effects.

When the second field season commenced just three weeks later, one of the first things noticed upon descent to the site was the tops of two sets of paired frames immediately north of the concreted wreck features that were not observed during the 1997 recording efforts (Wilde-Ramsing 1998). The hurricane had moved a wave of sand onto the site covering much of the southern expanse and reburying numerous features recorded the year before while scouring out and revealing new features immediately north of the concreted primary concentration of material. Fortunately, the storm appeared to have done little or no damage to any cultural material associated with site 0003BUI.

Once the frames were examined and additional handfanning revealed associated coherent hull structure, the decision was made to focus at least part of the 1998 effort on determining the extent of these remains and recording everything encountered in detail.

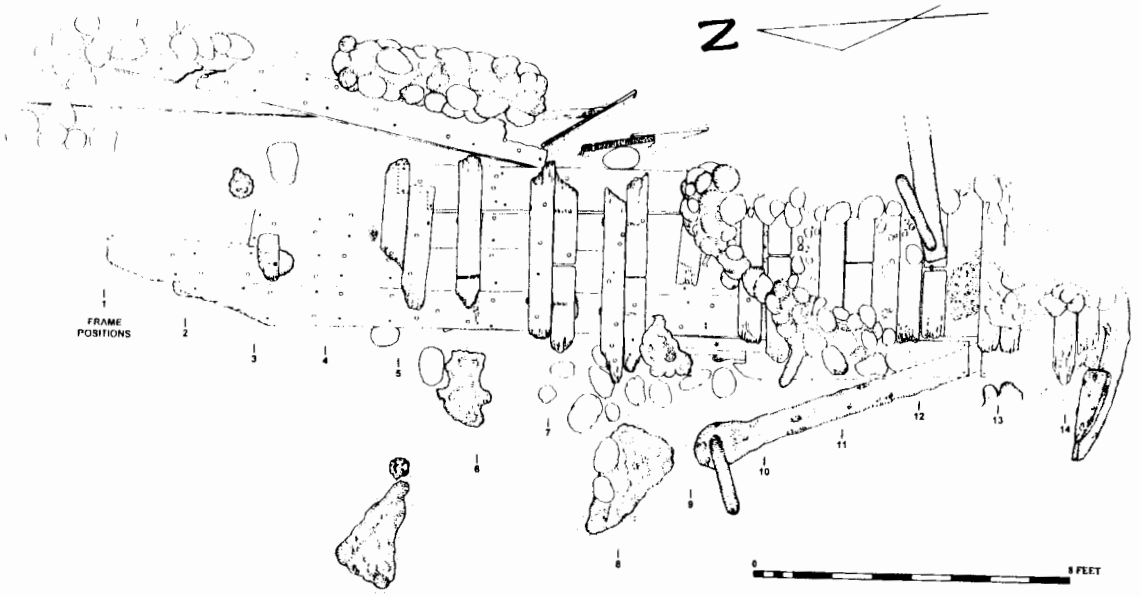

FIGURE 1. Structural Complex, Site 0003BUI, Beaufort Inlet, North Carolina. (Drawing by David D. Moore, North Carolina Maritime Museum and North Carolina Underwater Archaeology Unit.)

Underwater Archaeology, 1999:133–140.

Description of the Hull Structure

With an alignment or longitudinal axis lying very close to north-south (5° east of true north), the articulated hull structure is approximately 31 ft. (9.45 m) in length and around 9 ft. (2.75 m) in width (see Lusardi, this volume:Figure 1). This comparatively small section of ship's structure is made up of numerous fragments of frame components and bottom planking with associated sacrificial planking or sheathing. Unfortunately no sign of either the keel or keelson has been revealed to date. Additionally, no real clues currently exist to even suggest where on the original ship the present hull structure was positioned. The only diagnostic feature in this regard is the presence of sacrificial sheathing which at least suggests a position below the waterline.

Frames

There are 14 frame positions represented on the remaining hull structure at site 0003BUI (Figure 1). Twenty-four separate frame components (i.e., futtocks and possible floor fragments) make up the remains of 11 paired frames. These frame components range in width from 6 to 8 in. (15.24 - 21.29 cm) averaging 7 in. (17.78 cm). Though extremely deteriorated on most upper surfaces, moulded dimensions of the frames appeared to be around 8 in. (20.32 cm) where available for measurement. The room and space figure also varied slightly but averaged 22 in. (55.88 cm). Botanical analysis of several frame samples revealed *Quercus* sp. or white oak (Lee Newsom 1998, pers. comm.).

Many of the components exhibited simple squared butt joints, but whether these represent futtock/floor or futtock/futtock junctures is currently unknown. Transverse bolts were also present between framing components and positioned on either side of the respective butts. In several cases, the upper (inboard) faces of the frames were eroded down to these fastener positions by wood-boring organisms and natural degradation. Another interesting feature recorded was a white oak (*Quercus* sp.) shim positioned immediately beneath the single remaining component of Frame 6 (Lee Newsom 1998, pers. comm.). Tapering from 3/8 in. (1.00 cm) thick to almost nothing, this wedge measured approximately the width of the frame above by the width of the plank below.

Exterior Lower Hull Planking

The planks available for recording were within the range of 10 1/4 - 13 3/4 in. (26.04 - 34.93 cm) in width and averaged about 12 in. (30.48 cm). The planks varied in thickness only slightly and averaged 2 3/4 in. (6.98 cm). Botanical analysis of several samples all proved to be *Quercus* sp. or white oak (Lee Newsom 1998, pers. comm.).

There were three intact plank joints present among the structural assemblage and all three of different configuration. One, a typical squared butt joint, was located within the pile of concreted wreck material and beneath Anchor 1 at Frame 13. A second was located at Frame 3 and slightly beveled from a typical square butt. The third was recorded beneath the western extreme of Frame 5 and is something of an inversely beveled scarf joint, which would have facilitated a slight but effective locking mechanism between the two planks in that particular strake.

Sacrificial Planking or Sheathing

Sacrificial planking or sheathing, mostly sprung or otherwise dislocated, was observed and recorded in several different locations on the site but particularly in and around the articulated hull structure. The thickness varied between 3/4 and 1 in. (1.91 - 2.54 cm) depending on where recorded, but averaged around 7/8 in. (2.22 cm). The only example of an intact width was measured at 12 1/2 in. (31.75 cm). Botanical analysis revealed a *Sylvestris* group pine, most likely red pine (Lee Newsom 1998, pers. comm.). Interestingly, there was no hair and tar observed

associated with those sheathing planks located around the primary hull structure, though this matrix was recorded around the planks positioned just beneath the ballast ledge on the west side of the site. Though a laboratory analysis has not been completed at the time of this writing, a brief examination by a local veterinarian suggests that the hair is *Bovine* in origin (R. Guy Jaconis 1997, pers. comm.).

Fasteners

The somewhat normal fastening pattern was one spike and one treenail per plank/frame juncture, a pattern which alternated with each framing component. Treenail diameters ranged from 1 to 1 1/4 in. (2.54 - 3.18 cm) with no tightening wedges observed to date. Several samples taken for botanical analysis all revealed *Quercus* sp. or white oak (Lee Newsom 1998, pers. comm.).

Very few iron spikes have been recovered to date and fewer still conserved, but holes for spikes recorded in planks averaged 1/2 in. (1.27 cm) in section. Spike holes felt, but not observed, on the outboard faces of the planks appeared to be slightly countersunk to receive the spike heads, but this may have been a result of simply pounding the fasteners into place. The fastener holes recorded in the sacrificial planking were much more random than that of the bottom planks and smaller, averaging about 1/4 in. (6.3 mm) in square section.

Overall Ship Dimensions and Tonnage Calculations

Several primary sources provide an idea of the overall size of the *Queen Anne's Revenge,* ex-*Concorde* for utilization in the present study. Both the *Concorde* captain's (Archives Departementales Loire Atlantique [ADLA] 1719a) and lieutenant's (ADLA 1719b) reports of the capture of the ship in November 1717 mention that the vessel was of 200 tons, as does the 1717 commissioning roster (ADLA 1717). The question emerges at this point as to what this tonnage figure means in practical terms and whether it can provide enough information to add to the growing circumstantial database that site 0003BUI does indeed represent the remains of Blackbeard's flagship *Queen Anne's Revenge.*

Though tonnage figures have meant different things during different historical periods, as long as we are able to identify appropriate formulae, dimensional ratios, and other criteria, we should be able to at least manipulate the data and possibly calculate an acceptable dimensional range for the ship. There are a number of tonnage formulae available for use in these calculations which were utilized by the French during the period of the *Concorde*'s operations. Unfortunately, we do not currently know which formula may have been used and, in fact, documents suggest that more than one may have been utilized to determine the tonnage of the ship on any of the *Concorde*'s three known voyages. In 1713, the vessel's tonnage was listed as "250 (or 300) tons"; in 1715, "250 (or 200) tons"; and 200 tons in 1717 (Mettas 1984:16, 37, 56).

Following the decision to utilize the last known recorded tonnage figure of 200 in the calculations with the understanding that this might actually represent a low end or minimal tonnage, project researchers had to find appropriate ratios to maintain when using the tonnage formulae to reveal the ship's overall dimensions. Jean Boudriot, well known French ship historian and naval architect, provides appropriate ranges for dimensional ratios of French merchant vessels during the period in his excellent treatise *La Navire Marchand* (1991:28):

Overall length to beam (L:B) ratio range=3.41-3.68 (average=3.55)
Beam to Depth in Hold (B:D) ratio range=0.419-0.500 (average=0.460)

Additionally, the keel to beam ratio (K:B) of approximately three to one has been maintained where appropriate based on information provided by ship historian R. C. Anderson (1921:41-43). As long as applicable ratios of length:beam, keel:beam, and beam:depth in hold can be ascer-

tained and the tonnage figure is known, the formulae can be manipulated in reverse to reveal these dimensions.

Table 1 exhibits the results of utilizing several tonnage formulae known to French shipwrights and merchants during the late-17th and early-18th centuries (Roberts 1992:10). The Coulomb formula results in dimensions somewhat less than the other three, while the Pangalo, Morineau, and the anonymous formulae reveal results fairly similiar in value. It should be remembered that when using French formulae, resulting dimensions are in French measurements. The calculated dimensions based on the Morineau formula have been arbitrarily chosen to develop this exercise and converted to English measurement. In addition to the 200 ton figure, the Morineau formula has been subjected to a 300 ton calculation taking into consideration the mention of this figure on the *Concorde*'s first known voyage. Once these latter dimensions are converted to English values, researchers are provided with a basic range for the potential length overall of a 200-300 ton *Concorde* of 84.1 to 96.3 English ft.; keel of 71.0 to 81.4 ft.; beam of 23.7 to 27.2 ft.; and depth in hold of 11.0 to 12.6 ft.

It should be emphasized that this is an initial exercise based on very preliminary research and is simply intended to create a baseline of information through which continued observations and hypotheses can be developed. It is hoped that as both historical and archaeological research continues, additional documentation will surface to provide more clues to the ship's origin and size, and evidence of the hull will continue well beneath the extant cannon, anchor, and ballast mound to eventually reveal additional diagnostic structural features.

Ballast

One of the primary constituents associated with this particular site is the large volume of ballast concentrated in and around the central cannon and anchor features. While not an elliptical shape in the classical sense of a typical ballast mound, initial observations reveal that most of the material is concentrated in and around the primary concentration of cannon and anchor features (see Lusardi, this volume:Figure 1). Efforts are currently being made to interpret these ballast elements during excavation and following their recovery by weight, volume, and laboratory analysis.

One problem with ballast studies is determining the difference between primary and secondary elements among a pile of stones that may or may not have been dispersed and intermixed be-

TABLE 1.
FRENCH TONNAGE FORMULAE ANALYSIS

	Length	Keel	Beam	Hold Depth	Tonnage Variable
François Coulomb, Early 18th Century	*72.8*	61.6	20.5	9.5	200
Blaise Pangalo, 1689	77.5	*65.4*	21.8	10.1	200
Anonymous, 17th-18th Centuries	*78.1*	66.0	22.0	10.2	200
P. Morineau, 18th Century	78.9	*66.6*	22.2	10.3	200
P. Morineau, (in English Feet)	84.1	*71.0*	23.7	11.0	200
P. Morineau, based on 300 ton variable	90.4	*76.4*	25.5	11.8	300
P. Morineau, based on 300 ton variable(in English Feet)	96.3	*81.4*	27.2	12.6	300

All dimensions given in French feet unless otherwise noted.
1 French foot = 324.8 mm; 1 English foot = 304.8 mm
Variables in italics denote calculations derived from ratios and apart from the respective formulae.

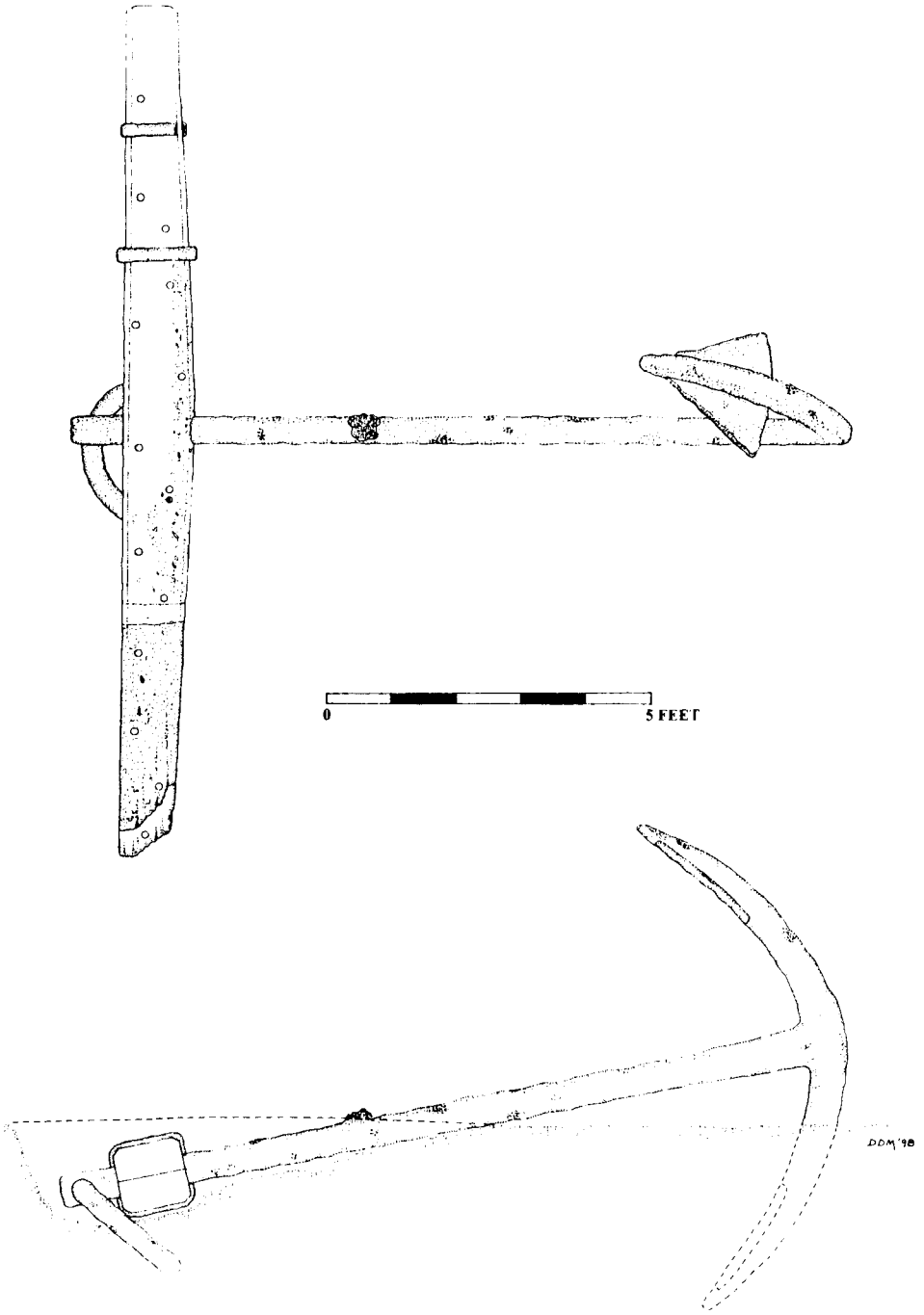

FIGURE 2. North Anchor (A3) Feature, Site 0003BUI, Beaufort Inlet, North Carolina. (Drawing by David D. Moore, North Carolina Maritime Museum and North Carolina Underwater Archaeology Unit.)

tween the original wrecking process and the present. Primary ballast would be considered those stones in the lower hull, potentially remaining from the ship's original lading. Secondary ballast are those upper level elements that were more apt to be shifted, added, and/or removed to make room for cargo, additional cannon, etc. to improve and ensure the vessel's stability, and hence could, but not likely, be from its point of origin.

A second problem would be that even if primary ballast elements can be identified within a relatively intact lower hull, it will not necessarily be assured that this particular layer of stones remains from the original lading of the ship and hence not reflective of any geologic signature near its origin. Two scenarios inherent to slave ships must be kept in mind. One is that slavers were notoriously filthy ships due to the refuse of human cargoes being routinely deposited into the lower hull prompting additional efforts to clean this area between voyages. This could include emptying the entire vessel of ballast during a careening process and scrubbing these spaces with hot vinegar while the stones were exposed on the beach to several changes of the tide. Though it might make sense that the stones would be returned to the ship in some semblance of order, this obviously cannot be guaranteed. Another thing to keep in mind is that slave ships were involved in a trading system which almost always dictated that they return to Europe with cargoes of extremely heavy hogsheads of raw muscavado sugar when available. Hence the ships required much less ballast in the form of stones, providing yet additional opportunities to displace portions of any extant primary ballast layer. And of course the longer the ship was afloat and the more voyages it made to various ports, taking on and eventually disembarking numerous cargoes of varying weights and volumes, provided an even greater possibility of primary ballast displacement.

And to make matters even more complex, there is always the good possibility that a vessel's initial load of ballast at launching was taken up from an area where ships, having come from all over the world, routinely dumped and loaded stones, ensuring a thoroughly global mixture of types available for future ships. This might be particularly true of the vessel if constructed at Nantes, due to this port's long history of seafaring dating back well before medieval times. Despite these potential interpretational problems, efforts will continue to perform a thorough ballast analysis.

TABLE 2.
ANCHOR SHANK LENGTHS

Anchor	Shank Length
1	11 ft. 4 in. (3.45 m)
2	13 ft. (3.96 m)
3	13 ft. 7 in. (4.14 m)
4	9 ft. 5 in. (2.87 m)
Grapnel 1	4 ft. 10 1/2 in. (1.49 m)

Anchors

Perhaps the most easily identifiable features upon descent to the site are the two large anchors that lie in essentially prone positions among the large volume of ballast stones, cannon, numerous barrel hoops, and other heavily encrusted and presently unidentifiable material. A third anchor lies approximately 50 ft. (15 m) north of the primary concentration of material (Figure 2) while a fourth is located about 400 ft. (122 m) south of this area.

Though somewhat camouflaged by the heavy concretion and encrusting marine organisms, a smaller grapnel-type anchor is discernible lying atop the pile and between Anchors 1 and 2 (see Lusardi, this volume:Figure 1). Unfortunately at least two of its arms have either deteriorated or been broken off. Although accurate recording must wait for recovery and eventual cleaning and conservation, all of the anchors have been measured to facilitate appropriate site plan placement and initial interpretation efforts (see Table 2). Both Anchors 3 (Figure 2) and 4 have nicely preserved wooden stocks remaining in situ.

Anchor 4, positioned approximately 400 ft. (122 m) south of the site proper, provides the most interesting interpretational scenario. Though its style could easily date to the appropriate period, the distance from the site obviously brings into question any potential association with the wreck currently under investigation as it could have easily been lost by another ship. However, the anchor's position and alignment pointing directly toward the site at least suggests a contemporary attempt to kedge the vessel off the bottom. Though historical documentation confirms that the *Queen Anne's Revenge* was abandoned on the Beaufort bar following its running aground, no mention is made of any kedging efforts by the pirates. This becomes important when attempting to interpret the historical events, as it is apparent from the trial records of some of the pirates who took part in the affairs at Beaufort Inlet that they believed that Blackbeard had purposely run the ship aground. David Herriot, who had been with the pirate captain for several months, deposed in Charleston that, "Twas generally believed the said *Thatch* run his Vessel a-ground on purpose to break up the Companies, and to secure what Moneys and Effects he had got for himself and such other of them as he had most Value for" (Herriot 1719:46). If Blackbeard did indeed run the ship aground on purpose, would he then have attempted to kedge the vessel off the bar? Or perhaps he was simply making his ploy appear all the more realistic. We shall probably never know the answer to this particular question, but the presence of Anchor 4 and its positioning does raise some interesting points for future discussions.

Conclusions

There is currently no conclusive proof identifying site 0003BUI as that of Blackbeard's flagship *Queen Anne's Revenge*; however, the circumstantial evidence is beginning to mount in its favor, which includes the location of the site, size and number of cannon and anchors, and type and dating of the various recovered artifacts.

In addition to this evidence, the remaining hull structure potentially provides some clues in determining the origin of the ship itself. Apparently the slaver *Concorde* was in the midst of its third voyage out of Nantes, France, when captured by Blackbeard and his cohorts during the Middle Passage between the West African coast and Martinique (Mettas 1984:56; ADLA 1719a, 1719b). Nothing is currently known of the ship before its first slave trading trip in 1713 and it is only suspected that its construction took place in France.

However, a shipbuilding treatise produced during the second quarter of the 18th century may help illuminate the origin of the *Concorde*. In 1737, the master shipwright of the Royal Dockyard in Brest, Blaise Ollivier, was sent to the major shipbuilding centers in Holland and England to collect extremely detailed data on construction practices. The resulting 360 page report finally published for the first time in 1992 provides some basic nationalistic characteristics of hull structures through which to draw some interesting conclusions (Roberts 1992).

Concerning transverse fasteners between framing components, Ollivier stated:

> The English shipwrights set up as we do several moulded frames which they space along the keel 7, 8 or 9 feet apart one from the other according to the size of the ship. These frames are made up of a floor timber, two first futtocks, two second futtocks, two third, fourth and fifth futtocks, like the frames of our own ships; and these timbers are fastened together one to another at each scarph by three treenails, in place of which we use three iron bolts. The English shipwrights in this regard do better than we. They make a saving in iron, they render the ship lighter, and the fastening is equally tight (Roberts 1992:65).

In discussing the bottom planks of the ships he observed and recorded, Ollivier added:

> The English shipwrights plank the bottom of their ships with plank of the same thickness as that used in our French ships, yet instead of fastening them as we do with one nail and one treenail to each frame, they fasten them with two treenails (Roberts 1992:52).

These statements by the shipwright Ollivier by no means prove anything conclusively; however, they do at least suggest that the lower hull represented at site 0003BUI appears to have been built by French shipwrights following practices mentioned in Ollivier's treatise as being normal in France during the period. The transverse fasteners recorded on the frames at the site are wrought iron in the French fashion rather than wooden and the French fastening pattern of "one nail and one treenail to each frame" is mimicked perfectly on the limited remains recorded to date.

The tonnage exercise and dimensional calculations provide a baseline of data through which future hypotheses and questions can be based. While proving little, these data do at least provide a range of dimensions which can be compared to additional hull structures excavated in future field seasons. The recorded room and space and the scantling of the respective framing components in relation to the bottom planking thickness certainly indicate a comparatively lightly-constructed vessel and not one along the same lines that might be expected of a typical naval ship of the period. This seems to suggest a smaller to medium-sized merchant vessel, albeit one which was obviously heavily armed in light of the 18 carriage-mounted cannon recorded to date on the site. One might easily be tempted to term this as characteristic of a typical pirate ship.

Both the ballast and anchor features, while interesting and continuing to undergo recovery, interpretation, and analysis, offer little in the realm of evidence to even suggest an association with Blackbeard the pirate. However, should geologists prove that large quantities of the stones from the site originated in the Loire River area of Nantes, France, then we should be able to add yet another piece of circumstantial evidence to the database which strongly suggests this to be the infamous *Queen Anne's Revenge*.

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A Phase II Excavation of a Possible Jeffersonian Gunboat

Introduction

The ideal archaeological project is one that fills gaps in the historical record and therefore provides previously unknown knowledge to scholars and enthusiasts. Using this definition, the investigation of site 18CV414 Vessel D1 may be an ideal archaeological project. Information regarding early-19th century U.S. Jeffersonian gunboats is limited and scarce. Vessel D1 has the potential to be one of these obscure vessels. If so, the archaeological investigation of this wreck will provide information concerning design, construction patterns, and any alterations to one of these gunboats. This project's main goal is therefore proving the identification of Vessel D1 while documenting its design and construction. Proving this vessel was a Jeffersonian gunboat will also identify it as a component of the only American naval defense on the Chesapeake Bay during the final year of the War of 1812.

Historical Background

The Chesapeake Flotilla

The Chesapeake Flotilla was a naval defense plan for the Chesapeake Bay during the War of 1812. The flotilla was designed and commanded by Commodore Joshua Barney. Barney's plan called for a small flotilla of gunboats and barges that could harass British raiding parties in the bay. These raiders were deemed vulnerable as the shallow waters of the Chesapeake Bay's rivers and streams forced the British landing parties to ferry in barges some distance away from their larger, deeper draft support ships. In addition to the required barges, several U.S. Navy vessels were placed under Barney's direct control. Two of the vessels were U.S. gunboats *Nos. 137* and *138* (Shomette 1981:21-25, 1995:55-63).

On the first cruise of 24 May 1814, Barney's Chesapeake Flotilla encountered the British Royal Navy's larger ships. Faced with a superior force, the flotilla was forced to retreat into the Patuxent River and was subsequently blockaded in St. Leonard's Creek, a two-mile tributary of the Patuxent. Throughout June 1814, several skirmishes occurred between the U.S. and British forces in St. Leonard's Creek. On 26 June 1814, with the help of militia and U.S. Marines, the little flotilla escaped the British blockade of the creek. Following the escape, the only U.S. naval defense in the Chesapeake Bay at this time traveled as far up the Patuxent as possible and destroyed itself to prevent enemy capture (Shomette 1981:38,43,45,48,50,84,89,96,183-184, 1995:64-81).

While in St. Leonard's Creek, Barney made a decision to rid his force of two poor-sailing vessels, gunboats *Nos. 137* and *138*. During the flotilla's shake-down cruise and its first mission, Barney quickly learned the inadequacies of his gunboats. *Nos. 137* and *138* were slow, they took in water, and generally held back the remaining flotilla. In order to facilitate the flotilla's escape on 26 June 1814, Barney made the decision to abandon and scuttle his two gunboats in St. Leonard's Creek. The British subsequently entered the creek, burned St. Leonard's Town, and burned the remains of the two vessels (Shomette 1981:38,101-103, 1995:82-83,90-91).

Jeffersonian Gunboats

Gunboats *Nos. 137* and *138* were originally constructed as part of a coastal defense system designed and employed by President Thomas Jefferson, his administration, and congress (Smith 1991:iv-27; Tucker 1993:20,28). The gunboat program has historically been labeled a failure. The reasons for this failure and those responsible are not in the scope of this article. Suffice it to say, the program did fail and whether historians

Underwater Archaeology, 1999:141–147.

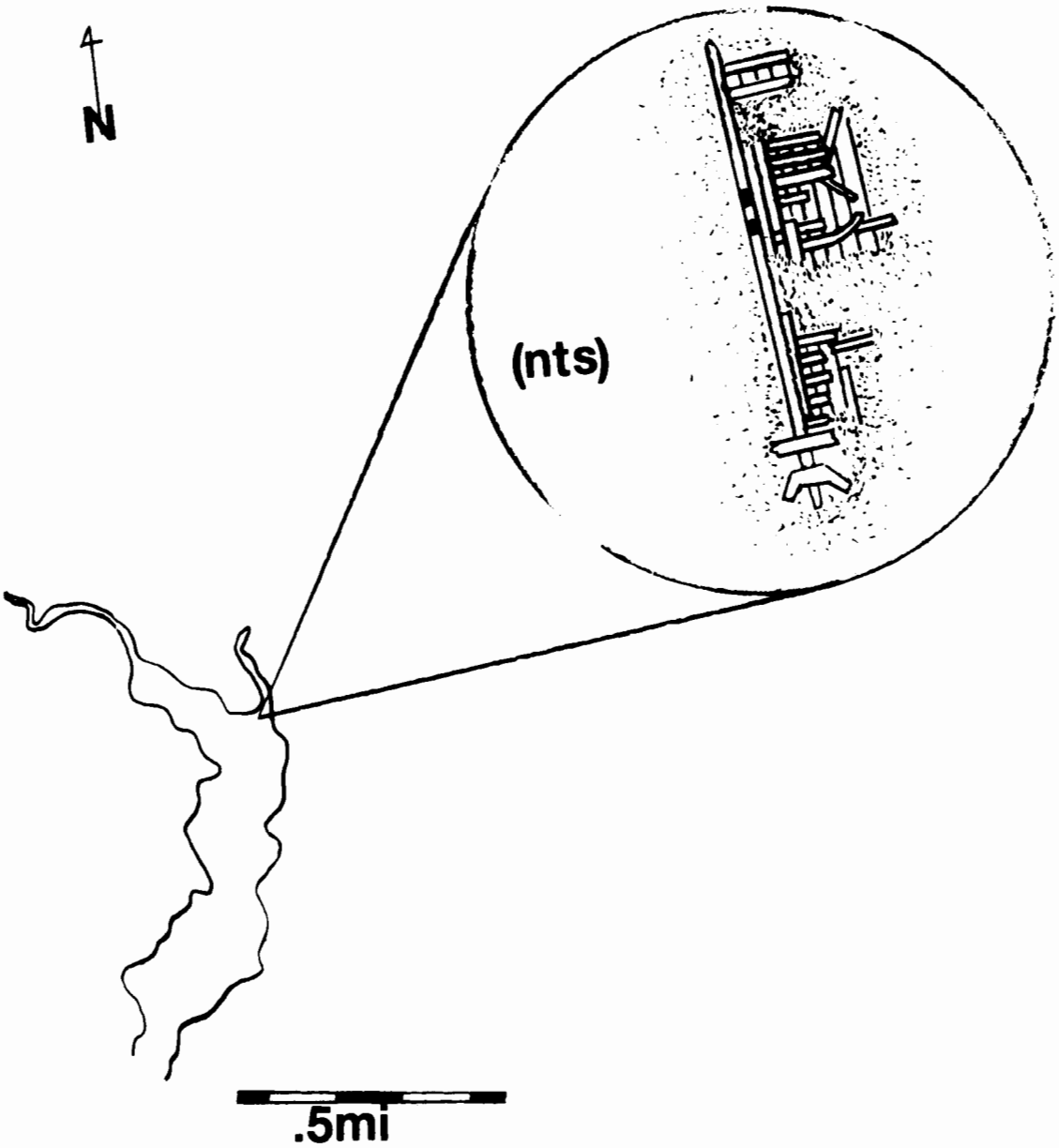

FIGURE 1. Head water of St. Leonard's Creek showing the old St. Leonard's Town peninsula. Inset: 18CV414 Vessel D1 site plan, not to scale. (Illustration by author.)

find it convenient to blame Jefferson or if he is simply an identifiable figure to attach to this program is arguable. In either case, the gunboats that comprised this defense system have been termed Jeffersonian gunboats.

The two Jeffersonian gunboats, *Nos. 137* and *138*, were part of the series 136-145 (total number recorded, 177) and were constructed at Baltimore in 1808 (Smith 1991:182; Tucker 1993:61). The two gunboats had varying careers after construction until their fateful meeting and demise in the summer of 1814.

Archaeology

A magnetometer survey was undertaken at the head of St. Leonard's Creek in April 1996. This survey and subsequent ground-truthing revealed a number of disarticulated timbers around the old St. Leonard's Town peninsula. A hydroprobe and another ground-truthing survey followed the initial survey in July 1997. The second survey located relatively intact vessel remains that were initially labeled Vessel D (Shomette 1998:7-10,16-19). In June 1998, a team of nautical archaeologists spent three weeks on the Vessel D site conducting a phase II investigation (Figure 1). Initial survey revealed a number of timbers surrounding the site that were obviously associated with a separate vessel other than Vessel D. Vessel D was therefore re-designated Vessel D1 (Babits and Enright 1998:1,3).

The following description of the June 1998 work and its findings draws heavily from "Preliminary Report, Flotilla Project, Site 18CV414" (Babits and Enright 1998).

Conditions on site consisted of shallow, cold water with zero visibility. Excavation was accomplished with a water dredge system and proceeded through muck 2 to 4 ft. deep. Once the top portion of the remains was uncovered, i.e. the keelson, excavation continued with more difficulty through oyster hash and hard-packed clay. Excavation through the clay deepened the trenches by another 3 to 6 ft. to reach the extreme bottom of Vessel D1.

Excavation focused on precisely located structural features that would best provide the necessary information to identify D1. These features included the entire keelson's length, the bow and stern areas, and a port and starboard transect. The latter was cut in order to map the framing pattern and uncover any material culture that might be found in a portion of the bilge.

The extant keelson measured approximately 40 ft. in length, was molded 9 in. and tapered bow to stern from 11 in. sided at the bow to 9 in. in the stern. Two maststeps were cut into the keelson and were separated by a mere 2 ft. (measured between forward edge of maststep one to aft edge of maststep two). Vessel D1 was a sloop-rigged vessel so the presence and location of the second maststep was more than likely a relocation of the mast to improve sailing qualities.

The starboard transect was excavated adjacent to the maststeps. Three ceiling planks, three first futtocks, three second futtocks, and nine outer planks were uncovered in a 7 1/2 ft. wide trench. The three floors were irregularly spaced, not doubled, and the first futtocks were not sistered to any floor. Floors at this point were notched to fit over the keel. The first futtocks' flat shape and hard chine made D1 a flat-bottomed, shallow-draft vessel. No other timbers were found outboard of the second futtocks; therefore these members were probably top timbers. Breadth and depth-of-hold measurements for D1 were not obtainable for a number of reasons; however, an educated estimate was possible. Based upon the positions and curvatures of the futtocks, Vessel D1's breadth would have been 15-18 ft. and its depth-of-hold between 4 ft. 2 in. and 4 ft. 8 in. (inclusive).

A port transect was cut across the keelson from the starboard transect. This was done to assess the extent of remains for the vessel's port section. Judging from the findings, Vessel D1's

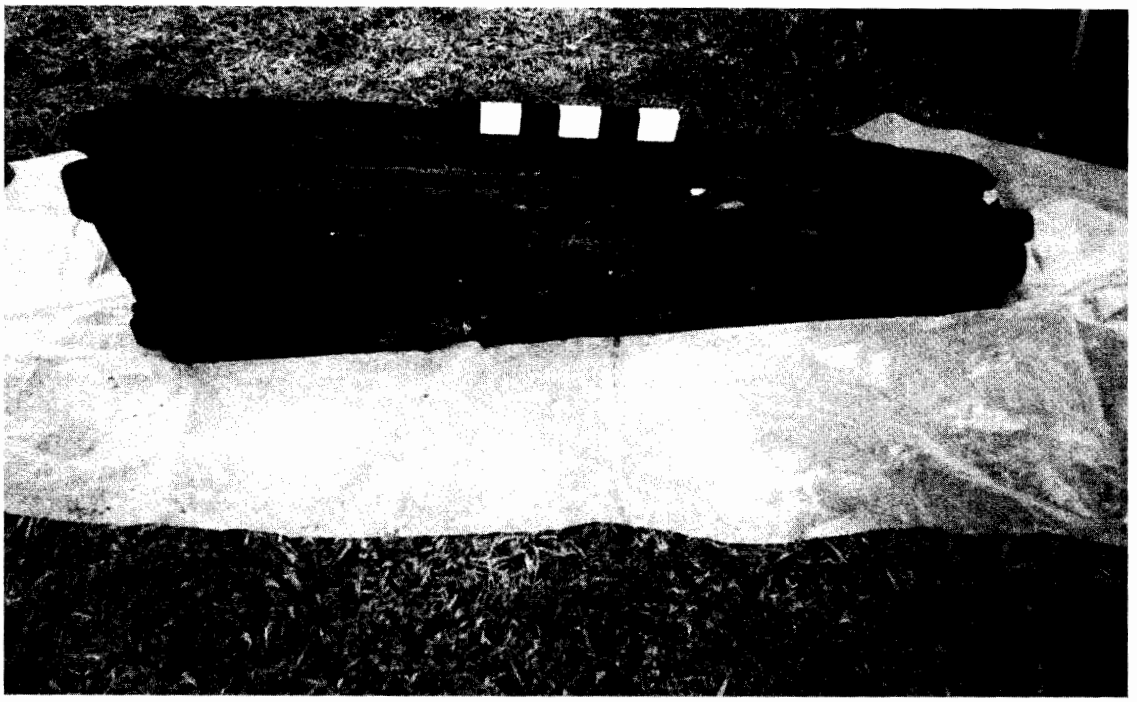

FIGURE 2. Vessel D1 extant sternpost showing rabbet, tenons, and fishplate notch. (photo by Jim Embry.)

port side is more intact than its counterpart. Frames were not accessible due to the presence of all ceiling planks outward to the terminus of the wreck.

Excavation in the bow of D1 focused on the entire forward end of the wreck and the starboard side of the immediate bow area. The bow remains on D1 consisted of three ceiling planks, two floors (starboard side), four outer planks, an apron, a gripe assembly (gripe and forefoot), the lower stempost or possibly a stempost knee, the keel, a false keel, and several timbers that may have been cant frames and hawse pieces. The presence of the latter and the curvature of the floors at this point gave Vessel D1 a full, bluff bow. Excavation in the bow, as well as the stern, uncovered a shoe or false keel on Vessel D1. This shoe was a massive timber measuring nearly 13 in. molded. The shoe was employed to protect against successive grounding by this shallow-draft, coastal vessel. The shoe's large size may have also been an attempt to improve lateral sailing resistance.

As in the bow, excavation in the stern focused on the entire end of the wreck and the starboard area immediately forward. Three ceiling planks, four outer planks, two floors, three first futtocks, two "Y" frames, a deadwood piece, the keel, the shoe, and a sternpost were uncovered. All longitudinal members, i.e. keel, shoe, and deadwood, tapered in the stern. Opposed to the floors of the starboard transect, the stern floors were not notched but rather both the keelson and the keel were notched to fit around the floors. The curvature of the floors at this point was much steeper than at the bow. Vessel D1's stern was therefore narrower than the bluff bow and had a more pointed design. The "Y" frames were large, single compass timbers that sat atop the deadwood piece. These timbers helped shape

D1's narrow stern section. The extant sternpost measured 4 ft. 2 in. and was found unattached to the wreck. Two mortise and tenon joints and fish plates originally attached the sternpost to the keel (Figure 2).

Little material culture was discovered during the excavation of Vessel D1. Ship fastenings and fittings constituted the majority of artifacts on the wreck. The remaining artifacts were limited in number, so it is possible to describe most of them in a short list. Uncovered were two partial blocks, a fish plate, a handle that may have been part of a belaying pin or quoin, a small brass button, the remains of a brush, two pieces of probable leather chafing gear, three 69-caliber musket balls, two possible impacted musket balls, numerous pieces of melted lead, some lead sheeting fragments, and over 100 small copper sheathing nails. The copper nails were discovered inside D1's hull and were therefore probably sheathing fasteners for an internal element. Possibilities for this element include a breadroom or magazine.

Interpretation

In order to prove the identity of Vessel D1 as either that of Jeffersonian gunboat *No. 137* or *138*, outside of disproving any other vessel identification, a number of important factors must be considered. First, we must show that gunboats *Nos. 137* and *138* were scuttled at the Vessel D1 location. The historical record, unfortunately, does not pinpoint the location of demise for these two vessels. However, by piecing together primary sources such as letters, sketches, and maps, the best possible location becomes the close proximity to the old St. Leonard's Town peninsula.

Next, the physical condition of Vessel D1 should match conditions provided in historical accounts of gunboats *Nos. 137* and *138* at the time of their demise. Accounts state the two gunboats were stripped and burned by the Americans, the British, and local inhabitants (Shomette 1981:101-104, 1995:83,143). The excavation of D1 uncovered a significant amount of burned wood throughout the wreck (Babits and Enright 1998:17). In fact, all small wood fragments excavated forward of the maststeps were completely burned. Additionally, a large amount of melted lead was discovered, suggesting fire (Babits and Enright 1998:17). The probability exists that the upper structure of D1 was set afire and as it disintegrated, the burned components fell into the bilge and bow areas. The fact that few artifacts existed on the site also suggests a vessel that was stripped. The lack of anything not tied down such as rigging, masts and spars, the rudder and bilge pump, sweeps, munitions, stores, or any cargo further supports this theory (Babits and Enright 1998:17-18).

Third, there should be no negative data on site that would date Vessel D1 later than 1814. One possible dating method is vessel design and construction. Construction elements on D1 did not date post-1814 (Babits and Enright 1998:15-16). The most important element that would exist in such a shallow-draft vessel as D1 after 1820 is the centerboard. Vessel D1 had no centerboard. Additional construction elements developed after the War of 1812 such as iron rigging and wire nails were also absent from the site (Babits and Enright 1998:15-16). The limited material culture additionally supports a pre-1814 date. The cuff button found is one similar to that used between 1790 and 1820 and the musket ball caliber certainly fit the time period (Babits and Enright 1998:15).

Vessel D1's original use must also be established. Since the vessel identification in question was a U.S. Naval vessel, D1's use should have been military and not commercial. The vessel's heavy construction, the lack of cargo, and the musket balls all suggest military use (Babits and Enright 1998:16). Construction techniques may also be an indication of use. Timber sizes on D1 are quite substantial for a 50 ft. vessel. Single floors at the starboard transect had an average measurement of 5-7 in. sided and 5-7 in. molded. Single floors at the stern measured 7 1/4 in. and 8 3/4 in. sided and were both

molded 13 in. between keel and keelson. Although frames were not sistered, single floor and futtock timbers were comparable to other early-19th century military ships. The War of 1812 Lake Champlain squadron vessels *Eagle*, *Linnet*, and *Ticonderoga* as well as the War of 1812 brig *Jefferson*, have proportionately similar frame dimensions (Crisman 1987:141-146). Vessel D1's stern floors closely match floor measurements of these larger ships. Timber sizes such as these on near-100 ft. and over-100 ft. vessels were massive on a 50 ft. vessel such as D1. Other construction features, especially the stern area, on Vessel D1 are quite similar to the *Eagle*'s design (Crisman 1987:139-140). Not only would these design similarities point toward military use but also early-19th century construction.

Finally, the design of Vessel D1's extant remains must match that of either gunboat *No. 137* or *138*. A little more detective work is necessary to prove this last requirement. Gunboats in the series 136-145, built at Baltimore, are thought to have measured 60 x 16 x 6 ft. 6 in. (Chapelle 1949:225; Smith 1991:182-183; Tucker 1993:61). In fact, these three measurements constitute the bulk of information available for these particular gunboats. Finding exact information on these vessels is, needless to say, difficult. This is due to the fact that few historical records concerning the Jeffersonian gunboats exist and those available have limited details. The designs of the gunboats were usually suggestions and the final construction was left up to the individual builder(s) (Tucker 1993:35). Changes were often made and not always documented.

However, two key fragments of evidence regarding the designs of gunboat series 136-145 were apparently discovered. According to Chapelle (1949:225),

> *Nos. 136* to *145* inclusive were built by Price and others at Baltimore on Barron's plan, 60' on deck, 16' 6" beam, and 6' 6" depth. According to the tenor of the correspondence they were sloop-rigged, but there is some indication that the plan in Figure 37 may have been used. The designs referred to in the official correspondence are not readily identified, and often, as in this case, the letters indicate that another design, rather than the one mentioned in the contracts or initial reports, was used to build the boats. *No. 143* was certainly on a smaller plan than Barron's, for Brewington discovered her customhouse measurements to be 51' x 17' 6" x 4' 2".

The figure that Chapelle (1949:203, Figure 37) refers to is a gunboat design with measurements 50 ft. 4 in. x 17 x 4 ft. 6 in. (Chapelle 1949:203). This design also calls for a 14 in. molded shoe to be added in some boats (Chapelle 1949:203). Vessel D1's overall dimensions, its shoe, rig, the degree of rake in the sternpost, its shallow draft and bluff bow, all either closely or exactly match the aforementioned plan (Enright 1999:15).

The two maststeps on D1 is also a vital clue to the vessel's identification. As stated above, gunboats *Nos. 136-145* were sloop-rigged. Commodore Barney related in letters his complaints concerning the two gunboats, *Nos. 137* and *138* (Shomette 1995:143). Barney was dissatisfied with the sailing qualities of these two boats. As stated earlier, they were slow, took in water, and generally held back the remainder of the flotilla. Is the second maststep located 2 ft. from the original an attempt by Barney to improve the sailing qualities of his little gunboat? This is merely circumstantial evidence and certainly not solid proof.

Conclusion

Work is still in progress with several more months of historical research and a second summer of archaeological investigation planned, but as of yet, no negative data disproving the gunboat identification has presented itself in either the archaeology or the historical record. No definitive proof, however, has been uncovered, but the amount of circumstantial evidence is becoming abundant.

Planned for the 1999 season are the continued investigations of Vessel D1 and the investigation of the vessel remains adjacent to Vessel D1. Gunboats *Nos. 137* and *138* were reported scuttled alongside one another (Shomette 1981:101-103, 1995:82). Perhaps following this investigation many more questions will be answered by the second vessel. Additionally, a number of merchant vessels from Barney's flotilla were scuttled in St. Leonard's Creek (Shomette 1981:101, 1995:82). Aside from the two vessels investigated during the 1998 field work, at least one other vessel, and possibly more, are present around the old St. Leonard's Town peninsula (Shomette 1998:19). Subsequent work on the Chesapeake Flotilla is therefore promising and this project will have extensive future possibilities.

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DAVE BALL

The Ironclad *Phoenix* and the Confederate Obstructions at Mobile Bay

In 1983 archaeologists from Espey, Huston, and Associates, Inc. (EH&A) were contracted by the U.S. Army Corps of Engineers, Mobile District to conduct a cultural resources investigation at Mobile Bay, Alabama, as part of a harbor improvement project. This investigation resulted in the identification of defensive obstructions located in the upper bay, just east of the main ship channel, which were erected by the Confederate Army Corps of Engineers during the American Civil War. Further field and archival research of these obstructions conducted through 1985 revealed a series of wood pilings and the remains of several vessels. As a result of the EH&A work, the obstructions were assigned Alabama State Historic Site number 1Mb28 and were listed on the National Register of Historic Places.

Results from the EH&A work were presented at the Society for Historical Archaeology's (SHA) Conference on Underwater Archaeology by Jack Irion in 1985, and in 1986 by Jack Irion and Dorothy Gibbons (Irion 1985a; Irion and Gibbons 1988). These papers described the work that had been done on three vessels (*Cremona*, *Carondolet*, and an unnamed flat) along the western arm of the obstructions. In addition to these vessels, EH&A archaeologists identified two other ships along the southern arm of the obstructions (*Phoenix* and *Thomas Sparks*). A paper on *Phoenix* was presented at the 1986 SHA Conference by Robert Gearhart (1986).

In 1993 researchers from Florida State University (FSU) returned to the obstructions to carry out further investigations on the ironclad *Phoenix*. This research was conducted as a student directed project for the FSU course Applications of Diving to Research. In addition to the results from the 1993 field season, presented below is a brief historical overview of the obstructions and the ironclad *Phoenix*.

The Obstructions

The upper bay obstructions were only a small part of the elaborate defense works that were erected around the city of Mobile during the Civil War. Fortifications, armed batteries, trenches, and channel obstructions were placed at strategic locations throughout the area to prevent the fall of the city. These defensive works were constructed and maintained by the Confederate Army Corps of Engineers, Mobile District.

Originally consisting of wood pilings, the upper bay obstructions were eventually reinforced with gun batteries along the north end and scuttled watercraft along the southern and western arms (see Irion 1985a:Figure 3). Gaps or gates were left within the obstructions to allow for the passage of blockade runners and supply vessels moving across the bay. These gates consisted of an opening within the obstructions with a stone boat or raft secured on the surface next to the opening that could be quickly scuttled to close the gate (U.S. War Department [USWD] 1921, I(21):363).

When the Confederate cities of New Orleans and Pensacola fell to the Union in the spring of 1862, Mobile became the only remaining port on the Gulf Coast through which the Confederacy could receive supplies. Once those cities fell, the engineers at Mobile began working in earnest to prepare the city for what they believed would be an imminent attack. Captain Charles Liernur of the Confederate Army Corps of Engineers, therefore, initiated a program of securing barges, flats, and other vessels, filling them with brick and rubble, and sinking them as obstructions during the spring and early summer of 1862. The attack, however, did not happen for about another two years, on 5 August 1864.

Several of the vessels procured by Captain Liernur were scuttled within the upper bay obstructions and appear on a post-war map (see

Underwater Archaeology, 1999:148–155.

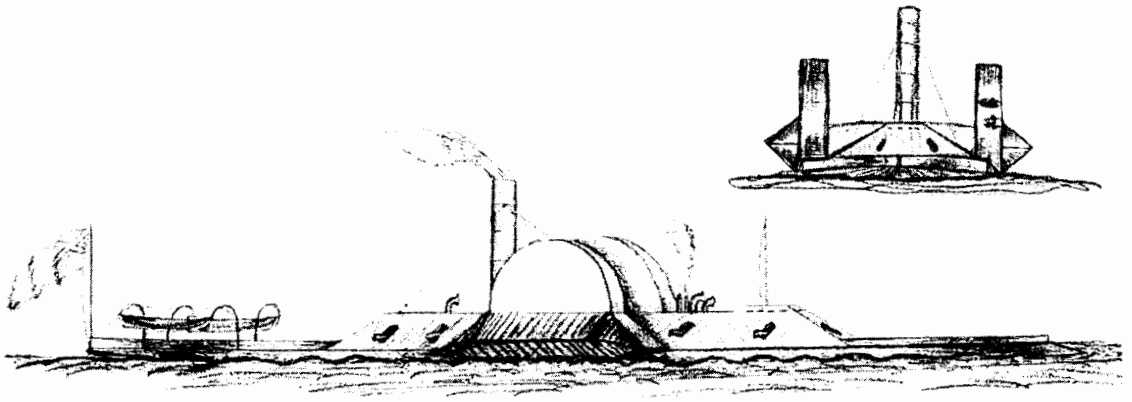

FIGURE 1. Sketch of the ironclad *Nashville*, sistership of *Phoenix*. (NA n.d.)

Irion 1985a:Figure 3), which was generated by Colonel Wm. Emery Merrill to identify the feasibility of reopening a ship channel through the upper bay obstructions. This map shows twelve vessels along the southern and western arms of the obstructions and gives some information on each. Vessels one, two, and three were identified and reported on by EH&A from 1983 through 1985 (Irion and Bond 1984; Irion 1985b, 1986). South of these vessels is a gap and then several other vessels running along the southern line. The last one, number twelve, is the ironclad *Phoenix*. *Phoenix* was a unique vessel due to its size and design. Constructed as an ironclad ram sidewheel steamship, it was one of the largest ships built by the Confederacy.

Phoenix and *Nashville*

Beginning the war with virtually no vessels in its fleet, and limited supplies and facilities for ship construction, the ships produced by the Confederate States Navy (CSN) were often unique in structure, and were rarely, if ever, built to original specifications. Of the vessels constructed by the Confederacy, the paddlewheel vessels were probably the most intriguing. These included centerwheel vessels of the *Missouri*-class, and sidewheel vessels of the *Nashville*-class (Holcombe 1993). The *Missouri*-class vessels were "diamond hull" ships (meaning the turn of the bilge was squared off, allowing for easier construction), designed for use on inland waterways. The *Nashville*-class vessels incorporated a more rounded or "standard hull" design and were originally intended for coastal and harbor protection. As Bob Holcombe, of the Confederate Naval Museum in Columbus, Georgia, has pointed out, the centerwheel *Missouri*-class vessels were perhaps better adapted for battle than the sidewheel *Nashville*-class because most of the paddlewheel was positioned within the ironclad casemate (Holcombe 1993:107).

The *Nashville*-class vessels were large, deep draft ships. It is generally agreed that the vessels *Nashville* (Figure 1) and *Phoenix* were both of this class (Gearhart 1986:4; Holcombe 1993:83; Ball 1998:57). These ships were both constructed at shipyards in inland Alabama, *Nashville* at Montgomery and *Phoenix* at Selma (Ball 1998:57). Construction of *Nashville* was contracted by the CSN to J. E. Montgomery and A. Anderson on 16 September 1862 (Holcombe 1993:91) with a contracted cost of over $660,000

(Luraghi 1996:439). Upon completion, as with many vessels built in inland Alabama, the vessel was towed down river to Mobile where it was to receive its armor and ordnance. Lack of materials, however, prevented the ship from ever being completed, and as a result it was unable to take part in the August 1864 battle of Mobile Bay. Once the Union fleet had taken control of the lower bay, *Nashville* was moved up river to avoid capture.

On 30 June 1865 a survey report of captured Confederate vessels was issued that included the ironclad *Nashville*. This included information on its specifications, which were as follows:

> Extreme length, 271 feet; extreme breadth over wheels, 95 1/2 feet; keel, 250 feet; shield on deck, 142 feet; breadth of shield, 40 feet; beam, outside, 62 1/2 feet; beam, inside 46 feet; depth, 13 feet; draft, 10 feet 9 inches. The *Nashville* is clad on the forward end of shield with three 2-inch iron plates, the lower plate laid horizontally and the two upper plates perpendicularly. The after end is clad with one 2-inch plate laid perpendicularly. The pilot house is clad with three 2-inch plates similar to the forward end of shield. The sides of shield are not protected. She has an engine connected with each wheel; cylinders 30 inches diameter, stroke 9 feet. She has seven 40-inch double-flued boilers. Engine and boilers in good order. Her armament consists of three 7-inch Brooke rifles and one 24-pounder howitzer. She was hogged when surrendered and is not strong enough to bear the weight of her full armor (USWD 1921, I(22):225).

On 28 March 1863 the CSN entered into a contract with John T. Shirley and David D. DeHaven for the construction of *Phoenix,* an "ironclad sidewheel steam War Vessel" to be built at Selma, Alabama, at a cost of over $666,000 (National Archives [NA] 1863). Construction of the vessel is believed to have begun around the middle of May 1863. Upon launching, the ship was severely damaged and was therefore sold in an effort to recover some of the money that had already been paid to the contractors by the CSN. The buyer (or buyers) of *Phoenix* are not known; however, it is believed the craft was sold to parties in the Mobile area. The only reference that has been found regarding the transaction comes from a letter dated 14 April 1864 by Commander Catesby Jones of the Naval Ordnance Works at Selma that said ". . . the boat has been sold to a company, who expect to load her with cotton and run the blockade. She was more badly broken than any vessel I ever saw" (Jones 1864).

Little information has been uncovered regarding the operations of the vessel from the time it was sold until the attack on Mobile Bay on 5 August 1864. When the Union fleet moved past the forts of the lower bay, the Confederate Engineers began to scramble to secure the city against defeat. This included closing a gap that had remained open in the upper bay obstructions for the passage of blockade runners. A vessel loaded with 500 tons of brick was scuttled; however, due to the flow of the river, within two days an 11 ft. deep channel had been washed out directly east of this gap. Therefore, Colonel Victor Scheliha of the Confederate Army Corps of Engineers ordered *Phoenix* to be towed within the line of obstructions to serve as a gun battery and to fill the gap across the channel. Since the maximum depth of the bay at this location was around 13 ft. and the draft of *Phoenix* was probably close to 10 ft., much of the vessel would have remained visible above the water.

A letter dated November 1864 from J. F. Gilmer to Confederate Secretary of War James Seddon stated that the vessel had been seized by Brigadier General E. Higgins and that the amount of $644,307.34 would be paid by the Navy to the current owners (Gilmer 1864). While no information has been found referring to the owners of the vessel, the Gilmer letter did state that Julius A. Pratt acted on their behalf.

On 15 August, Union Admiral D. G. Farragut made a reconnaissance expedition to the upper bay and reported the vessel *Nashville* as blocking any further Union naval advance toward the city of Mobile (USWD 1921, I(21):529-530). Farragut apparently mis-identified *Phoenix* as its sistership *Nashville*. On 24 August, USS *Metacomet* made a second expedition to the upper bay. During this trip, *Phoenix* was boarded

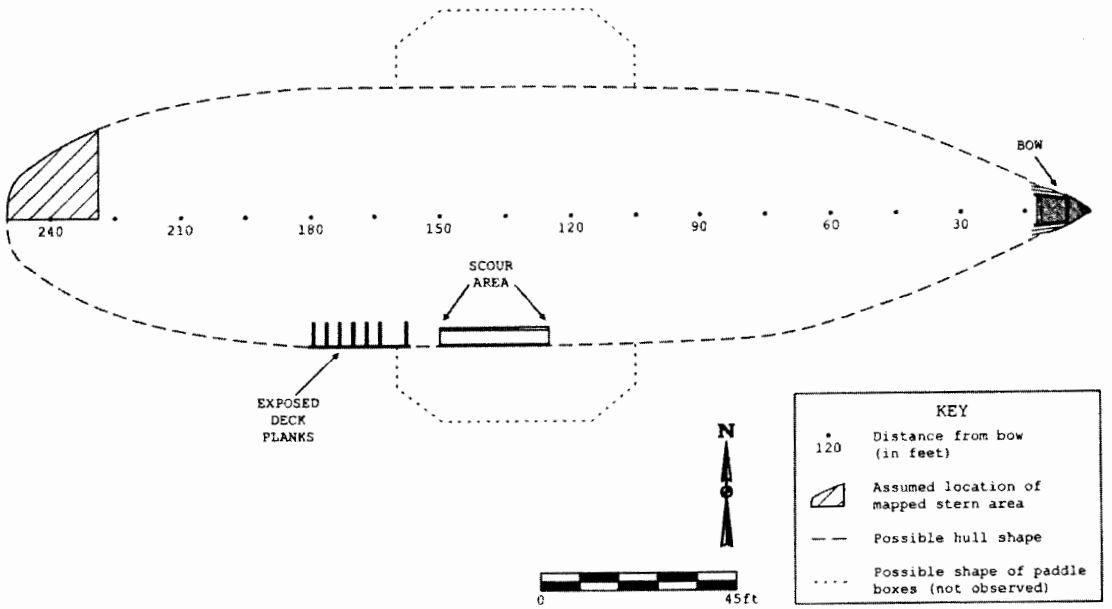

FIGURE 2. Possible outline of *Phoenix* showing areas surveyed during the 1993 FSU investigation. (Based on archaeological and historical research.).

and charges were placed on the vessel in an attempt to destroy the ship and open the channel.

However, Confederate accounts of the event confirm that it was *Phoenix,* not *Nashville* that was in the obstructions. After the explosion, a damage assessment was made by the Confederate Army Corps of Engineers that described the event as causing severe damage to the fore-starboard area of the vessel (Scheliha 1864). In order to prevent further attack on the ship, the Confederate Engineers at Mobile ordered *Phoenix* burned to the waterline. This was the last recorded action taken on the vessel during the war. Though the Union fleet was able to move in and capture the lower part of Mobile Bay, the placement of *Phoenix* across the southern gate of the upper bay obstructions prevented further advance toward the city. As a result, it was not until 12 April 1865 that the city finally fell, three days after Confederate General Robert E. Lee surrendered at Appamattox, Virginia.

Archaeological Results

Three dives were made on *Phoenix* during the 1985 EH&A investigation; of these only one produced any measurements. The ship was measured at a length of nearly 250 ft., running approximately east/west, with a combined outer hull/ceiling planking thickness ranging between 2 in. to 3 in. Analysis of a remote sensing survey conducted during the 1985 field season suggested that the approximate width of the vessel was nearly 45 feet. Iron bands were identified at the eastern end of the vessel, suggesting the location of the bow. Areas of the upstream side of the ship were found to be scoured out exposing almost 8 ft. vertical depth of hull, and piles of

brick were encountered at the bow and stern areas. However, no machinery was observed (Gearhart 1986).

In 1993 researchers from FSU returned to the obstructions to document the remains of the vessels *Phoenix* and *Thomas Sparks* (an iron-hulled tug that wrecked on the obstructions in 1866). Only five field days were available for this investigation, and as a result, emphasis was placed on recording *Phoenix*. Once the vessel was relocated, buoys were placed at its bow and stern, and a baseline was placed along the approximate center of the wreck, pre-marked in 15 ft. increments to provide reference points for divers as they surveyed along the vessel.

A cursory survey of the wreck was conducted and mapping of prominent features then took place. The primary areas of concentration were the bow, stern, and midships sections. From the 1993 investigation, an hypothesized outline of the vessel was created (Figure 2). It is important to note that this outline is merely speculation based on a combination of archaeological and historical information. Included in Figure 2 is an outline of the approximate location of the paddleboxes, though no evidence of them was noted.

Phoenix currently lies upright, with most of the hull structure intact. Intact deck planking was observed at both the bow and stern. The

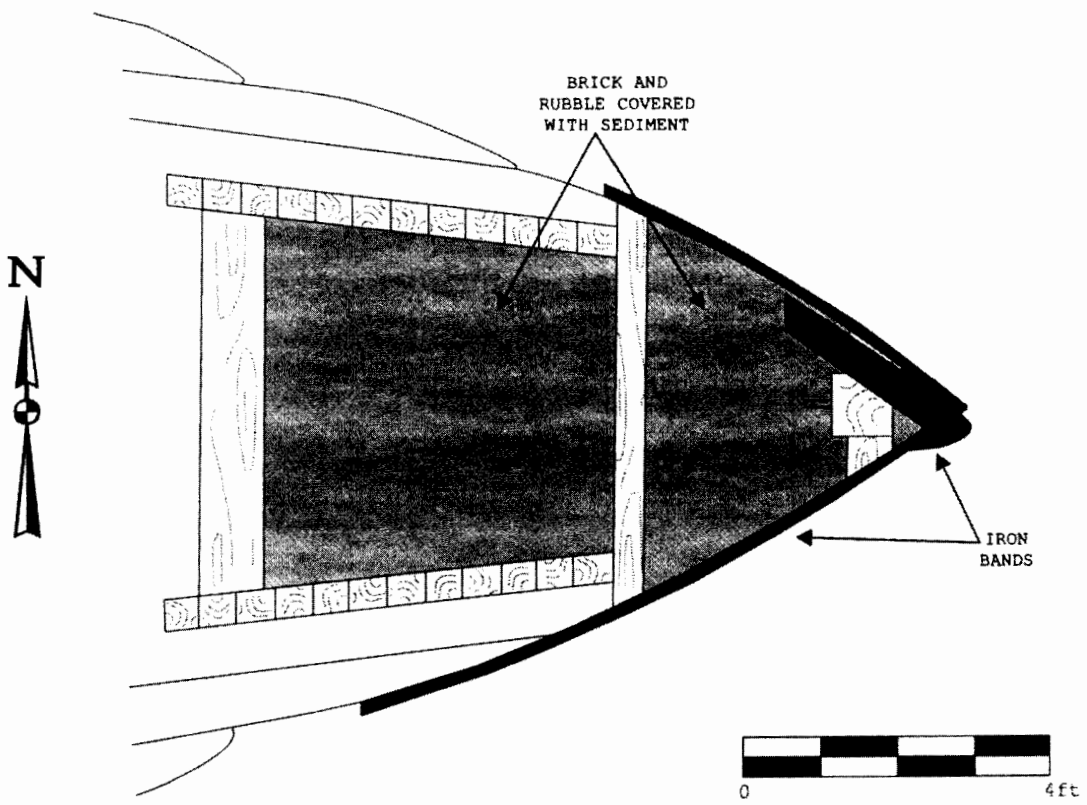

FIGURE 3. Plan view showing eastern end (bow) of *Phoenix*.

bow was found to rest approximately 3 ft. out of the sediment. A subsurface probe, placed directly in front of the bow, revealed a possible wooden feature at a depth of approximately 2 ft. Iron re-enforcement remained on the extreme forward end of the bow (Figure 3). It consisted of several iron bands that measured 6 in. wide by 2 1/2 in. thick. The iron bands ran approximately 10 ft. along the starboard and 6 ft. 6 in. along the port side of the bow. One band had fallen from its original position and was observed to lie directly over the bow with both ends buried in the sand. Part of the hull construction was observed behind the iron re-enforcement. This consisted of heavy timbers that lie across and upright throughout the bow. The shaded areas within Figure 3 appeared to consist of more timbers that were covered by thick silt and brick. The presence of heavy re-enforcement timbers at this end, in conjunction with iron re-enforcement as observed during the 1985 and 1993 surveys, seem to confirm this end of the vessel as the bow.

Except for a few minor breaks, the hull of the ship could be followed along its starboard side from bow to stern. Along this side, from about 125 ft. to 150 ft. from the bow, there existed a scour area where the sediments inside the ship had been washed away from the hull. At that point the hull was exposed to a depth of over 10 ft. This may have been close to the same scour area that was reported by Gearhart during the 1985 investigation. Of significance at that point was the identification of a prominent turn of the bilge on the inside of the vessel. This would suggest that the vessel followed the "standard hull" design and not the more easily constructed "diamond hull" design. Along the inside hull bottom, a beam was located 3 ft. from the side of the hull. This is most likely either a bilge keelson or a footwale. The upper section of planking in this area was beginning to detach from the hull due to deterioration and bay currents. The fastening pattern, used to attach the planking to the hull, was also noted here. It was comprised of 1 in. iron drift pins, fastened diagonally. At 165 ft. and 205 ft. from the bow, along the starboard hull, the remains of two hanging knees were encountered.

From approximately 155 ft. to 180 ft. from the bow, along the starboard hull, an area of deck support beams was exposed. Of note at this point was the observation of a 3 in. groove that was cut through the top center of each of these beams. The beams were uniformly spaced 3 ft. apart, except for a missing beam at 162 ft. from bow.

The final area to be mapped during the 1993 survey was the stern. This area was primarily covered with intact deck planking. Also in this area, a section of beams were encountered that are extremely well preserved. These beams lie immediately below the deck planks. Since the vessel would have been built to withstand the impact of enemy artillery, these beams most likely served to absorb the impact of artillery and to re-enforce the deck.

The 1993 survey focused primarily on the starboard side of the wreck because it was relatively well exposed. However, minor observations of the port side were also noted. A large percentage of the port side was found to be covered with shrimp netting. The presence of this netting may be helping to preserve this side of the vessel by adding resistance to the effects of current flow from the Mobile and Apalachee rivers, which are located north of the obstructions. It was also noted that certain areas rest high enough in the water column to have been damaged by engine propellers from modern boat traffic. One final observation was that a large round timber was found to run through the center of the ship at approximately 164 ft. from the bow. Unfortunately, only a cursory observation of this was made and, though it is possible that this timber may have been part of the paddlewheel propulsion system, it is more likely that it is merely a log that floated downstream during heavy rains and has lodged itself within the wreckage.

In addition to gathering information from *Phoenix*, the remains of an unidentified craft, lying between *Phoenix* and *Thomas Sparks*, were

also noted during the 1993 survey. FSU researchers returned in 1995 to document part of this vessel (Hammel 1995). This may be the vessel that was scuttled on 5 August 1864 in an attempt to close a gate within the obstructions.

Conclusion

Work that was done to construct and maintain the Confederate obstructions in upper Mobile Bay served the Confederacy well. Though the obstructions themselves were a formidable obstacle to the Union Navy in its quest to capture the city of Mobile, the addition of the ironclad *Phoenix* to the upper bay obstructions made an assault by water virtually impossible. As a result, the Union Navy was unable to capture the city during the battle of Mobile Bay. Additionally, further naval assaults were also deterred.

Archaeological investigations of the obstructions, and associated vessels, have only begun to document the potential information that can be obtained from this unique feature. Since it is known that damage continues to occur to *Phoenix*, it can be assumed that similar adverse effects have occurred and continue to impact other vessels within the obstructions. Therefore, further documentation of the Confederate obstructions is necessary in order to gain a better understanding of the significance of this historic site. It is hoped that this work will serve as a springboard for future archaeological research on the vessel *Phoenix* as well as the Confederate obstructions.

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