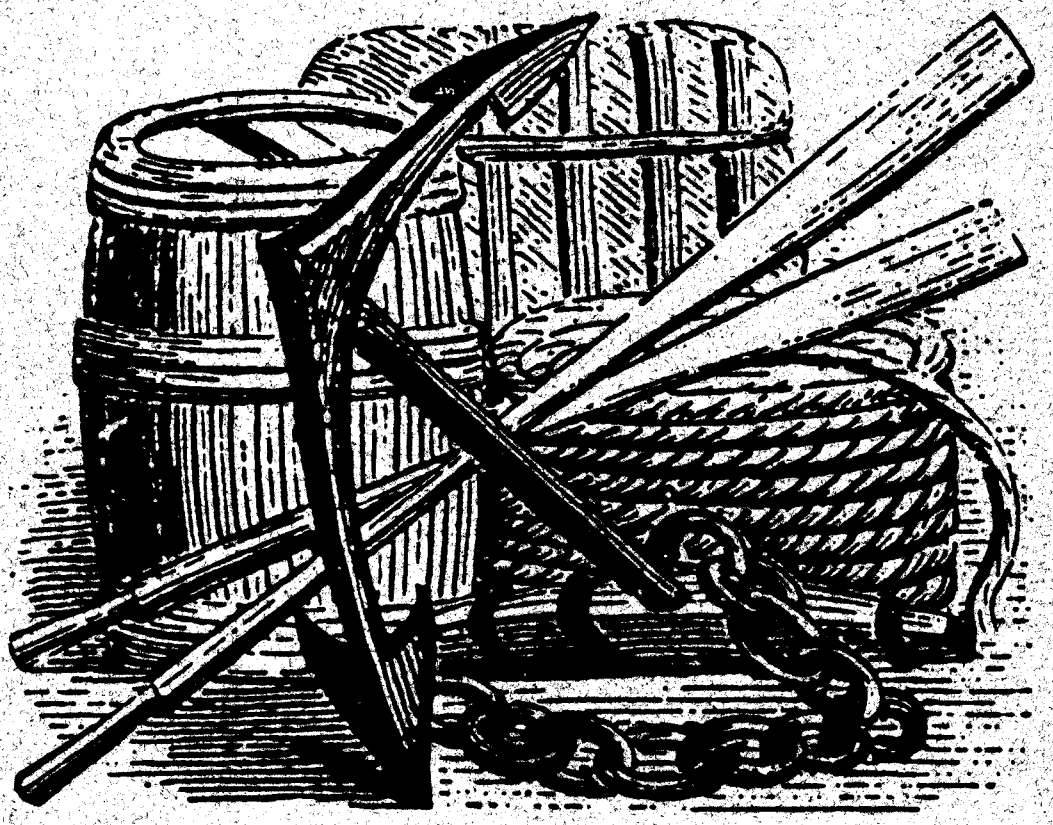
UNDERWATER ARCHAEOLOGY PROCEEDINGS FROM THE SOCIETY FOR HISTORICAL ARCHAEOLOGY CONFERENCE

ALAN B. ALBRIGHT, *Editor*



Society for Historical Archaeology
Savannah, Georgia 1987

UNDERWATER ARCHAEOLOGY PROCEEDINGS FROM THE SOCIETY FOR HISTORICAL ARCHAEOLOGY CONFERENCE

ALAN B. ALBRIGHT, *Editor*

Savannah, Georgia 1987

Published by
THE SOCIETY FOR HISTORICAL ARCHAEOLOGY
RONALD L. MICHAEL, Editor

Print Production by
Braun-Brumfield, Inc.
Ann Arbor, Michigan

Contents

ADDITIONAL PAPERS

THE SOCIETY FOR HISTORICAL ARCHAEOLOGY

EXTENDS ITS APPRECIATION TO

MR. ROLAND YOUNG,

PRESIDENT OF THE SOUTH CAROLINA

UNDERWATER ARCHAEOLOGICAL RESEARCH COUNCIL

FOR HIS FINANCIAL ASSISTANCE IN PUBLISHING THESE PROCEEDINGS

ALAN B. ALBRIGHT

FOREWORD

The Society for Historical Archaeology Conference on Historical and Underwater Archaeology was held in Savannah, Georgia, during January 7 - 11, 1987. This is the 18th annual meeting in which both terrestrial and underwater archaeological papers were presented jointly. Over 80 underwater papers were given and 47 are presented in this volume. As in preceding conferences, topics spanned over two thousand years of history and from many parts of the globe.

The conference was hosted by the Center for Low Country Studies, Armstrong College, the U.S. Corps of Engineers, and the Coastal Georgia Archaeological Society, Inc. The list of co-sponsors appears on page ii of the program and the efforts of those organizations and their staff are greatly appreciated.

As in the past, the Savannah Conference was the product of many governmental and educational entities and many individuals. They are too numerous for all to be mention here but special thanks are due to Kathy Levitt of Armstrong College, Georgia, through whom Larry Babits, Conference Chair, Nick Honerkamp, SHA Chair, and I, CUA Program Chair, coordinated our efforts and turned to for help too many times to mention. Judy Wood of/and the Savannah District, U.S. Corps of Engineers were responsible for printing the program. Carol Ruppe, as always, organized and splendidly managed the Book Room. J. Barto Arnold III, Chairman of the Advisory Council on Underwater Archaeology and other council members were always very helpful when called upon for advice. The enjoyable annual banquet was hosted and partially sponsored by the Coastal Heritage Society of Old Fort Jackson.

I appreciate the efforts of Kenn Pinson Head of the Publications Division of the South Carolina Institute of Archaeology and Anthropology for the editing advice he gave me, and to Ann Salters and Mary Custodio of his staff for their contributions in preparing art work and photography. Also my thanks goes to Diane Moses and Deb Barshafsky for typing the papers into the computer, to Ashley Chapman and my wife Penny for helping me proofread the material, and to Mark Newell for his advice and assistance. On a more personal level I appreciate the free time I was given by the Institute director, Dr. Bruce Rippeteau, to work on the Proceedings during regular working hours. Ronald L. Michaels, Editor for The Society for Historical Archaeology was always ready with advice when I needed it, and showed great patience in explaining the process of putting this publication together.

This publication represents the first incursion by the Society for Historical Archaeology into the realms of "electronic publishing". The articles received from the authors were transcribed into Microsoft® Word and formatted using Aldus PageMaker® . This publication was put into an Apple® Macintosh™ owned by the South Carolina Institute of Archaeology and Anthropology and was printed on an Apple LaserWriter™ owned by the Kershaw County Public Library, of which my wife is the Director. Computer Source/Connecting Point of Columbia, SC let us use their equipment during off hours and on weekends and Spencer Whetstone, of their staff, put in too many hours to count in formatting the Proceedings. This was my first attempt at electronic publishing, or any other publishing for that matter, and I have come away from the experience with two conclusions. First that electronic publishing is the way to go. Second, that the same person should contract to do it for a number of years. The process of learning how to use electronic hardware and software systems, should not have to be undertaken cold by a new editor each year. Also staying with the one system will assure continuity of form and style.

Back issues of the 9th CUA Proceedings may be purchased from the Texas Antiquities Committee, P.O. Box 12276, Capitol Station Austin, TX, 78711. Back issues of the 10th through the 14th CUA Proceedings may be purchased from Fathom Eight, P.O. Box 80505, San Marino, CA, 91108. These back copies represent a broad spectrum data base for reference and research and should be in the libraries of both terrestrial and underwater archaeologists.

Alan B. Albright
South Carolina Institute of
Archaeology and Anthropology,
University of South Carolina,
Columbia SC, 29208

SYMPOSIUM

ROBERT F. MARX

The Manila Galleons

The first of the fabled Manila galleons crossed the Pacific in 1565. The last one put into port in 1815. When the line began, Philip the Second was king of all the Spains and his enemy, Elizabeth Tudor, was queen of England. Hernan Cortes, conqueror of Mexico, had been dead but eighteen years. The same year Pedro Menendez de Aviles laid the foundations of St. Augustine in Florida. When the last Manila galleon sailed it was already five years since Miguel Hidalgo had begun the revolt against Spain which was to create the Republic of Mexico. The United States had been a nation for forty years and Andrew Jackson had just won the battle of New Orleans.

Yearly, for the two and a half centuries that lay between, the galleons made the long and lonely voyage between Manila in the Philippines and Acapulco in Mexico. No other line of ships has ever endured so long. No other regular navigation has been so trying and dangerous as this, for in its two hundred and fifty years the sea claimed dozens of ships and thousands of men and many millions in treasure. As the richest ships in all the oceans, they were the most coveted prize of pirate and privateer. The English took four of them, - the *Santa Ana* in 1587, the *Encarnacion* in 1709, the *Covadonga* in 1743, and the *Santisima Trinidad*, largest ship of her time, in 1762.

To the peoples of Spanish America, they were the China Ships or Manila Galleons that brought them cargoes of silks and spices and other precious merchandise of the East. To those of the Orient, they were silver argosies, laden with the Mexican and Peruvian pesos that were to become the standard of value along its coasts. To California, they furnished the first occasion and motive for the exploration of its coast. To Spain, they were the link that bound the Philippines - and, for a time, the Moluccas - to her, and it was their comings and goings that gave some substance of reality to the Spanish dream of empire over the Pacific.

The Manila galleons were the largest ships the Spanish used. In the sixteenth century they averaged about 700 tons; in the seventeenth century the average was 1,500 tons; and in the eighteenth century they were between 1,700 and 2,000 tons. Three or four of these ships sailed annually in each direction until 1593, when a law was passed keeping the number of sailings down to two a year in each direction.

The voyage from Acapulco to Manila was usually pleasant enough, with only an occasional storm unsettling the routine sailing of from eight to ten weeks. On the other hand, the voyage from Manila to Acapulco was known as the most treacherous navigation in the world. Because the winds in the Philippine latitudes are from the east, the Manila Galleons had to beat their way as far north as Japan before reaching the belt of westerly winds which would carry them across the Pacific until they made landfall on the coast of California and then worked their way down to Acapulco.

This voyage took from four to eight months, depending on luck. Counting the crews, from 300 to 600 persons sailed on each galleon with an average of from 100 to 150 of them perishing en route from epidemics, scurvy, thirst, starvation, or the cold. On one of two Manila Galleons sailing jointly in 1657, all 450 persons aboard succumbed to a smallpox epidemic. About half the 400 aboard the other galleon also died.

Notwithstanding the great risks to life, ships, and property involved in this navigation, the financial gain accruing to those involved in the Manila Galleon trade and to the Royal Crown seemed well worth the hardships. The cargoes carried from Acapulco to Manila were basically the same as those carried on the flotas between Spain and the Indies ports, except that silver specie and bullion were also carried on these galleons, coming from the mines of Peru and Mexico to pay for the cargoes sent to Manila. The Crown restricted the amount to be sent to Manila at 500,000 pesos a year, but like many other laws, this was almost always disregarded so that an average of 3 to 5 million pesos were sent to Manila annually. In 1597 the fantastic amount of 12 million pesos reached the Asian port.

The cargoes plying the route from Manila to Acapulco were of a more exotic and diversified nature. The main item was silk from China and Japan of varied types. There were crepes, velvets, gauzes, taffetas, damasks, and grosgrains. Packed in chests were silks in every stage of manufacture from lengths of raw silk to finished apparel - robes, kimonos, skirts and stockings. Finely embroidered Chinese religious vestments, silken tapestries and bedcoverings were also shipped. Fine cottons from the Mogul Empire of India comprised a good part of the cargoes during the latter part of the trade as were Persian carpets, imported into the Philippines via India.

In addition the Manila Galleons carried exquisite jewelry including pendants, earrings, bracelets and rings. There were gem studded sword hilts, rugs, fans, combs and a wide range of precious spices and drugs (including rhubarb which was much sought after in Europe). The ships carried a great deal of beautiful Chinese porcelain ware, objects carved of ivory and sandalwood, gold bells, copper cuspidors and exquisite and unusual devotional pieces such as crucifixes, reliquaries, rosaries and religious sculptures in wood, ivory and gold, crafted in the Orient for Roman Catholics.

Considerable gold in the form of bullion or manufactured articles was exported to Mexico. Though there was a legal ban on the importation of jewelry from the Orient, in a large consignment confiscated at Acapulco in 1767 there are enumerated hundreds of rings, many of which were set with diamonds and rubies, bracelets, pendants, earrings and necklaces and a number of gold religious articles including a cross set with eight diamonds. On the same occasion officials also seized "a golden bird from China", some jewel-studded sword hilts, and several alligator teeth capped with gold. many unset or uncut gems were also carried to Mexico by the Manila Galleon. Henry Hawks, an English merchant who spent five years in Mexico in the sixteenth century wrote: "There was a mariner that brought a pearle as big as a doves egg from thence, and a stone for which the Viceroy would have given 3000 duckets."

When the richly laden Manila Galleons reached Acapulco, merchants arrived from as far away as Peru and a fair was held at which the bulk of the goods was sold. Peruvian merchants would carry their newly acquired merchandise down to Panama City and sail home later in the year on the ships of the Armada of the South Seas. Mexican merchants had their goods carried over the mountains by mules. The agents who represented the merchants in far off Seville also used mules and travelled all the way to Veracruz to board the New Spain Flota back to Spain.

More than 90 per cent of all the Manila Galleons lost over the centuries went down in Philippine waters. Ships sailing for Mexico foundered on treacherous reefs or fell victim to typhoons before they were far from Manila and even though the Acapulco-Manila route was less hazardous overall than the route east to the New World, once the heavily laden galleons entered the waters around the Philippines they entered dangerous territory.

Dozens of Manila Galleons lie beneath the seas around the Philippines. Unlike so many of the treasure galleons lost in the New World, none has ever been found or salvaged. They sank in deep water, beyond the reach of Spanish Colonial salvors but well within the reach of modern salvage efforts.

In 1985 the National Museum of the Philippines began issuing permits for the location and excavation of all classes of shipwrecks. Currently two British, one French, and one American expedition are searching for Manila Galleons as well as for Asiatic trading ships dating back as early as the 8th century A.D.

ROBERT F. MARX
205 ORLANDO BLVD
INDIALANTIC FL. 32903

WILLIAM A. BEYREUTHER III

The USS *CONSTITUTION* Museum: Telling The Story of a National Symbol

USS *Constitution*, or "Old Ironsides", as she has been popularly referred to since the War of 1812, is the oldest commissioned warship afloat in the world, and certainly the best known naval vessel ever to have served the United States. Millions of Americans have trod her decks and millions more have read of her exploits.

Constitution is a national symbol. Her construction was, arguably, the greatest technical achievement of eighteenth-century America. She has been the subject of uncounted drawings, paintings, prints and photographs. The building of an "Old Ironsides" model, whether from kit or scratch, is considered by many model shipwrights a rite of passage. They graduate to the 44-gun frigate from an apprenticeship spent on smaller, less complex vessels.

Constitution is such an integral part of the American scene that many of the million prints produced in the 1920s of Gordon Grant's "Old Ironsides" oil painting are still to be found hung with pride over fireplace mantels, in office, and on the walls of family rooms across the nation. The more I travel, the more I see of them.

If *Constitution* is so well known, the subject of so much scholarly ink and the focus of such artistic endeavor, don't we know all there is to know about her, from forward sickbay to after captain's cabin? The answer to this must be an emphatic "No." Research has yielded a great quantity of information on her career and the careers of those men who have served aboard her, but we have barely begun to tell those stories. We have, in fact, barely begun to unravel them.

We are lucky that "Old Ironsides" is still around at all. The logs of her many cruises, in times of war and peace, tell of dozens of occasions on which she might, but for skill and good fortune, have been lost. She might have ended up on a slavage yard in 1830s had the public not rallied to her defence, spurred by the sentiment which found expression in Oliver Wendell Holme's stirring poem. "Tear her tattered ensign down," indeed!

Constitution entered the present century as a receiving ship. She was an anachronism, an invention of the eighteenth century which suddenly found herself in the twentieth. Her greatest glory was behind her, but she was still to travel, and there were many stories yet to unfold.

By the 1920s "Old Ironsides" had been twenty years without an overhaul; she was in sad shape. The Navy cured many of her ills with a three-year rest in Dry Dock Number One in Boston's Charlestown Navy Yard. Before her emergence in 1930, *Constitution* had undergone substantial replacement of structural members, and had to some degree been restored to her War of 1812 appearance. Public contributions to the restoration effort, despite national economic hardship, covered two-thirds of the nearly $1 million expense.

The Navy sent the old frigate off on her final long voyage to reward the American people for their support of the restoration. This "National Cruise" took her, under tow, to dozens of ports along the Atlantic, Gulf, and Pacific coasts over a three-year period. By the time she returned to Boston in 1934 she had logged some 22,000 miles and accomodated over four and a half million visitors.

Constitution returned home a floating museum, laden with gifts from her visitors. Her dockside presence in ports such as San Francisco, Galveston, and here in Savannah sent local residents into their attics for naval history memorabilia. Schools and community organizations presented her officers and crew with plaques, silver plate, and books. These items were displayed aboard the ship for decades to come, augmented by later acquisitions.

By the early 1970s the decks of "Old Ironsides" were so filled with cased and framed displays that the public found it difficult to see the artifact they were most interested in, the frigate herself.

The need for another major structural overhaul provided the opportunity to solve the problem of shipboard overcrowding. A group of Boston-area businessmen with strong Navy ties chartered the USS *Constitution* Museum Foundation, a nonprofit corporation, in 1972. The ship's restoration was to begin the following year, and the Navy was convinced that its own interests would best be served by the long-term loan of the *Constitution*- related artifacts, memorabilia, artwork, and archival materials to this private institution.

The Foundation began its life with an abiding love for "Old Ironsides," the purpose of telling her story and that of the American sailing Navy, and little else. Its collection, with the Navy loans at its core, was initially displayed in temporary quarters during the search for funding for the rehabilitation of the building chosen for the Museum's permanent home. This structure, appropriately enough, was the pumphouse for *Constitution's* restoration dry dock. It had been employed for a variety of industrial purposes since the 1830s, and its location two hundred yards from the ship was nearly ideal.

Renovation completed and exhibits in place, the Museum opened its doors to the public early in 1976. Although it lies within the boundaries of the Charlestown Navy Yard section of the Boston National Historical Park, the Museum is not operated by the National Park Service. It does have a Cooperating Site Agreement with the Park Service, and also enjoys an excellent relationship with the Navy, which owns, maintains, and staffs, the U.S.S. *Constitution*. The ship's crew members, active duty Navy personnel, provide tours of the vessel, drawing on training provided by the Foundation.

The USS *Constitution* Museum Foundation has for the past decade sought to provide its visitors with an educational experience which complements and expands upon the tour of the frigate herself. The Museum's focus might, to someone unfamiliar with the institution, seem dangerously narrow. We do concentrate on the interpretation of a single ship, but do not feel that this precludes the presentation of exhibits and programs on more general topics, from the history of the sailing Navy to maritime crafts.

A visit to the Museum begins in an exhibit devoted to the frigate's construction which gives the public an opportunity to learn more about her physical structure than can be gained from the tour of the ship herself. Full-size sectional models of bottom structure and gundeck convey detailed information on construction methods and materials, providing hands-on impressions of the massive oak hull which earned the name "Old Ironsides" in August of 1812.

Successive exhibits treat *Constitution's* rigging and sails, plus her heroes, including such naval luminaries as Isaac Hull, Edward

Preble, and William Bainbridge. An interactive computer game puts visitors in command of the ship. They must take her from Boston to Gibraltar in the year 1803, during the Barbary Wars, and their command decisions are evaluated by a "Secretary of the Navy" in software form.

A "Life at Sea" gallery introduces the public to living conditions aboard an early nineteenth-century warship. The responsibilities of various officers and crew members are delineated, and a greater degree of empathy is perhaps fostered through the identification of five individuals who did indeed serve aboard the frigate.

The themes of death and destruction are not celebrated, but the consequences of armed conflict are treated in "The Honors of War," a fifteen-minute audiovisual presentation tracing the activities of Amos Evans, *Constitution's* surgeon during her 1812 engagement with HMS *Java* off Brazil.

The periodic overhauls which have kept *Constitution* alive for 189 birthdays are briefly interpreted in our Preservation Gallery, which also displays memorabilia, including items manufactured from structural materials removed from the ship during those overhauls. A professional ship modeler plies his trade here while fielding questions from curious visitors.

A final gallery is employed for temporary exhibits. It recently contained a three-year exhibition entitled "Isaac Hull" A Forgotten American Hero." This show featured artifacts showered upon Captain Hull by his grateful fellow citizens following his victory over HMS *Guerriere,* and represented the Foundation's most ambitious research effort to date. Perhaps some of you saw this exhibition while attending the 1985 SHA/CUA Conference in Boston.

The Museum walkthrough just recounted described where the Foundation is now, based on research already conducted. As noted earlier, however, it is obvious that there is much still to be accomplished. Each of the current exhibits would benefit from the infusion of new data, and new exhibits, the lifeblood of a successful museum, must be mounted on a regular basis.

The raw material for these exhibitions certainly exists, much of it within our own holdings. We are presently scouring our modest, but growing, Samuel Eliot Morison Library and other available sources for information on *Constitution's* only around-the-world cruise, a two-year voyage undertaken in the 1840s for both diplomatic and commercial reasons. The story of the World Cruise will be told by the Museum in an exhibition which will initially contain a component highlighting the frigate's April 1845 visit to the sultanate of Brunei, on the northwest coast of the island of Borneo. The Bruneians will have the opportunity to tell their own story in this component, which is expected to become a traveling exhibit. Its place of honor in the "Around the World Cruise Gallery" will then be filled by successive components on other ports of call.

The Foundation recently began inventorying prints depicting its favorite frigate, starting in the U.S. Naval Academy's Beverly R. Robinson Collection. The bicentennial of *Constitution's* launch will be upon us in ten years; before it arrives we plan to have published a volume on "Old Ironsides" prints, with another to follow on paintings. A third publication is to be a photographic history of the ship.

The Museum has within the past year and a half assembled a fine representative collection of Federal Period naval small arms which will form the nucleus of a small arms and ordnance exhibit. Interpretation will deal not only with the technical aspects of the weapons and their use, but also with the social and economic impact of their manufacture and trade.

The Museum's plans for expanded exhibits and educational programs are sufficiently ambitious that the Foundation is now working with the National Park Service to arrange for the rehabilitation and lease of an adjacent building. These plans for expansion are predicated upon further research on the topics I have mentioned. Funding for the research necessary for exhibit development, however, is often difficult to come by in a relatively small museum lacking an endowment, and we simply do not have a large enough staff to do all the necessary work.

I see three potential solutions to this problem. First, we need to identify previously untapped sources of interns possessing the skills necessary for historical and artifactual research. Second, we can employ additional volunteers. The Museum is fortunate to have the services of a dedicated group of volunteer guides, one of whom has recently assumed responsibility for our library cataloging. I believe that if we can communicate our research needs to the membership, perhaps through our newsletter, we will get additional assistance.

Both of the solutions just suggested will benefit all concerned parties. The Museum, obviously, will obtain information on specific topics at low cost. Interns will gain experience, some receiving college credit and a stipend for their efforts. Volunteers will have the satisfaction of helping their favorite museum achieve its goals. They will also, I expect, recognize this as an opportunity to learn more about particular subjects they have been wondering about themselves.

The third way in which the Museum can get assistance in obtaining the information it needs to develop its exhibits and programs is quite simple, but easily overlooked. Staff members of institutions with collections sometimes tend to think that visiting researchers are being done a favor when they are granted access to those collections. Perhaps we occasionally lose sight of the fact that outside researchers using our collections are actually strengthening our institutions by gathering and synthesizing data on our artifacts, works of art, and archival materials.

There is much still to be learned about *Constitution,* the American frigate Navy, and related topics. Two subjects which are badly in need of more detailed examination are naval small arms manufacture and naval medicine. The Federal Period small arms in our collection include several dozen items of both American and European origin. Over thirty late eighteenth-and early nineteenth-century volumes on the practice of medicine, most from the library of *Constitution* surgeon Amos Evans, recently came our way. These and many other objects in our collections await study. I consider our holdings an underutilized resource, and hope that this situation will be soon remedied.

I am not suggesting that everyone possessing an interest in a Federal Period naval topic call or write me with a long list of questions and the expectation that our small staff will answer them. I am, however, inviting inquiries from serious researchers interested in the content of our holding. We will gladly accept copies of research reports in return for the information!

WILLIAM A. BAYREUTHER III
USS *CONSTITUTION* MUSEUM FOUNDATION
P.O. BOX 1812
BOSTON, MA 02129

SYMPOSIUM

FRED GREGORY

Save Ontario Shipwrecks: Project Organization and Financing

My paper is not project or site specific, but rather, discusses the legal aspects of wreck stripping as they apply to the Province of Ontario; the organization of Save Ontario Shipwrecks (SOS); our relationship with the Government of Ontario; and, how we run our own archaeological projects and obtain our own funding.

Souvenir collecting by irresponsible divers is a problem and has been recognized as such for many years. In Ontario, Canada, with few exceptions, the Province lays claim to all bottom lands and any objects lying on them. Therefore, all wrecks rightfully belong to the crown in the right of the Province, unless true ownership can be established. Wreckstripping or site destruction is, therefore, illegal and punishable by a number of indictable offences ranging from theft, to practicing archaeology without a license, to taking or possessing "wreck" without authority. However, legal proceedings have generally proven ineffective in dealing with such matters. Also, if it can be avoided, we would rather not see any diver go to court over one of these offenses.

Save Ontario Shipwrecks believes there is a better way - education and peer pressure. It is our opinion that most divers take things out of ignorance, not truly appreciating the destruction they cause. Most divers want to dive on intact wrecks and we have found that if appraised of the situation, they will not take part in activities destructive to the site. Furthermore, when educated divers see others destroying their dive and heritage sites, they will take steps to police the situation themselves, reporting the offender to their Club or legal authority. There have even been cases where divers were denied air and charters (mostly by their peers) because of their known wreck-stripping activities.

Save Ontario Shipwrecks

Save Ontario Shipwrecks was incorporated in 1981 with aims to further public knowledge and appreciation of Ontario's maritime heritage. We do this, through assisting museums and archives in gathering historical information and artifacts; by educating the general and diving public; and, by encouraging divers to survey, document, and preserve shipwrecks in Ontario's lakes and rivers. Our major thrust is to prevent wreckstripping. SOS currently has 350 members in 14 Local Chapters covering all of Ontario. All are involved in many types of projects, however, emphasis is placed on amateur underwater archaeology. We take this tact, since experience has shown that marine heritage conservation holds little interest to the uninitiated. Underwater archaeology, on the other hand, grasps the interest of non-divers and divers alike, even if it is just perceived as yet another ticket. The product of this activity provides us with researchers and historians interested in their maritime past, educators to "spread the word", and avid gathers of archaeological data.

SOS Projects

All Chapters are involved with one or more projects. Chapters often get started over a local concern for, or interest in a specific site or shipwreck. Most projects are considered archaeological in nature and are conducted under an archaeological license issued by the Province. This is done to comply with the Heritage Act and ensures that: the applicants know what's involved and expected of them; they comply with standard archaeological practices; and, they file a full report at the completion of the project.

Some examples of SOS conducted projects are:

a. Establishing an inventory of the resource: This is accomplished by having divers complete a specially prepared form (designed by Provincial Archaeologist) over the course of diving on their favorite wreck. The form is completed under an archaeological license and itself constitutes the required report;

b. Major archaeological projects: These, for the most part, fall into non-disturbance archaeology and could be of a small or large scale extending over several years. They could involve the entire Chapter and are conducted under the guidance of Provincial Archaeologists.

c. Other:

- providing a labour pool for the professional community
- placing buoys and plaques on wrecks;
- developing interpretive trails;
- refurbishing wrecks and returning artifacts;
- taking inventory of artifacts long since removed;
- producing information pamphlets; and,
- presenting talks to clubs and historical societies.

In response to the concern over permitting amateurs to perform underwater archaeology, the fact remains that in Ontario, no one else is doing anything about it. Furthermore, it is usually the dive community who locates these sites and they have demonstrated they are eager and capable of the task. There exists approximately 96 thousand square miles of bottom lands in Ontario, representing an area the size of New York State. There are countless thousands of potential archaeological sites and an estimate of over 4,000 wrecks in the Great Lakes alone. There are also very few qualified marine archaeologists. The Province of Ontario, specifically the Ontario Ministry of Citizenship and Culture employs two and they are responsible for marine archaeology and heritage conservation for the above area. Since it is impossible for two individuals to accomplish this task alone, they support and encourage the involvement of marine heritage groups like SOS. To them they provide training and instruction, offer hands-on experience, and extend assistance. They have placed their professional trust in groups like SOS and are now reaping the benefits. SOS and this Ministry enjoy a very beneficial and symbiotic relationship. The SOS program assists this Government Ministry, taps the expertise of the diving community, identifies the resource, gains valuable archaeological data and in the long run, promotes conservation. The SOS archaeological program is for everyone. We do not certify divers as "marine archaeologists". To everyone who is interested, we offer knowledge and techniques in underwater archaeology. Those who do dive, use this skill as a tool to assist with a project. SOS believes its members are para-marine archaeologists who have responded to a challenge. Together, we protect a finite and non-renewable resource.

Funding

In general, SOS obtains funds from within, first. We are prepared to go it alone, are not in it for any financial profit. Our members are all volunteers and we rely greatly on our own resources. We use our own dive equipment, vehicles and boats, and locally manufacture any necessary equipment. We have found, that within most groups, there exists many talents to assist with every facet of a project.

In addition to membership fees, government grants are available

for administrative purposes and to fund specific projects. SOS is also a charitable organization and can offer tax deductions for gifts, donations and other services. We often rely on interested benefactors for supplies and office space.

In addition, our organization is funded by the Ontario Heritage Foundation (OHF). The OHF is an agency of the Provincial Government who's mandate is to foster understanding and participation in preserving Ontario's heritage. To date, their support has been one of the largest sources of project funding. These grants permit us to purchase necessary equipment, provide our members with transportation and air, and assist with publishing our final reports.

Other government departments offer matching grants for specific equipment, assistance with the placement of historic plaques, and the loan and provision of equipment, expertise and services.

The local community should not be overlooked. Heritage activities provide a valuable community service and most will help if approached the right way. From some communities, SOS has received financial assistance, the use of facilities for camping and accommodation, equipment loans, transportation, and compressed air from the Fire-hall. Local dive clubs have provided funds in recognition of the improvement we provide to their dive sites.

Additional sources of funding may be found in "T" shirt sales, draws, treasure hunts, etc. Industry is also eager to have a part, and a little good publicity can go a long way. Many members employed with large companies may have access to equipment, time-off and other donations. Dive stores will also loan equipment and donate air, since our activities bring increased numbers to their shops.

Success of our Program

All SOS projects have proven very successful. SOS has gained international recognition for our success in preventing wreckstripping, our success in convincing divers that shipwrecks are part of their heritage, the research and historical network we have developed, the high quality archaeological work we do, and the research reports we produce.

Our success stems from involving everyone with the many and varied aspects of marine heritage and archaeology. We have found that involvement and trust produce a spirit of cooperation in the dive community and in the long run, provide a far greater reward than any artifact on someone's mantle.

Save Ontario Shipwrecks sincerely hopes that, in the near future, we will see the day when no further damage will be done for the sake of a rusty lawn ornament.

FRED GREGORY
6065 FORESTGLEN CRES
ORLEANS, ONTARIO
K1C 5N6

PETER C. ZWICK

Guns of Punta Salis

By the late eighteenth century several nations had made attempts to standardize their cannon. Englishmen Armstrong, Robbins, and Muller as well as Frenchmen St. Rémey, Valliere, and Jean Baptiste Gribeauval were among the most successful. Prussia's Frederic the Great, the Dutch, and th Swedes also made significant contributions to the science of gunnery during the century. Considering this attention aimed at obtaining the perfect design of guns, one would believe that it should be an easy task to identify cannon from the various nations found at shipwreck sites dating to this period. If you've ever tried to do it, you know it isn't easy at all.

It's been my experience to find that ample reference material exists regarding English cannon of eighteenth century vintage, but relatively little data has been recorded concerning artillery of other nations. In particular, Spanish cannon data seems to be very sparse. We hear so much about Spanish Galleon sites, but little has been written about the guns of these ships.

In August, 1986 INAH and INA investigated a mid-eighteenth century shipwreck located in the waters of Cozumel, Mexico. The author considers this site, Punta Salis, as a test case in an attempt to conclude nationality of the cannon and perhaps nationality of the ship from the guns at the site. From preliminary research of other artifacts discovered there, a 1759-1800 date has been assigned to the wreckage. Rococo art styles on a few of the artifacts would indicate that the wreckage occurred closer to 1759 than 1800. Similarly, shape of wine bottle fragments found point toward a pre-1780's date of foundering. However, to be cautious, we'll use the 1759-c1800 date. Handles of cutlery are continental European in style and appear to be the forerunner of the fiddle style of the late eighteenth and nineteenth centuries.

By 1759, General Vallieré (1732), General Armstrong (1736), Saint-Rémey (1741), Benjamin Robbins (1742), and John Muller (1757), had all made contributions to the design of artillery. Jean Baptiste Gribeauval made a profound impression on cannon design beginning in 1765 and by the 1780's many of his theories and those of Robbins and Muller became a reality in design of artillery for many nations.

Perhaps the guns at Punta Salis may be approached by an attempt to prove that they are not English or French and therefore they could be Spanish or Swedish. Sweden was also an important supplier of iron cannon to many European nations, especially guns for arming ships.

To date, seventeen iron cannon have been discovered at Punta Salis. A few more guns are located near the site but they have not as yet been connected with the wreck in question. Sixteen of the guns have a + 262 centimeter length with a + 10.7 centimeter diameter bore. One cannon is + 185 centimeters long and has a + 8.4 centimeter bore. Little or no coral has been removed from the guns, so all measurements are to be considered as being approximate. Iron shot at the site measures 4", 3", and 2 inches in diameter. The 2 inch diameter shot was used in one pounder swivel guns. These dimensions indicate that the guns are English sized nine and four pounders, or continental European sized eight and four pounders.

English ships of mid-eighteenth century carried nines and three's in the 24 to 28 gun class ships and were about 500 to 600 tons in weight. Ships of this class were about 115 feet long and had a 32 feet wide beam. Vessels of twenty guns or less carried only one size of cannon - nine pounders, six pounders, or four pounders. French naval vessels of thirty guns carried twenty-six twelve pounders and four four pounders. French ships of twenty guns had 20 eight pounders (Louis de Tousard 1809).

One could conclude that if this ship had English guns, there should be more guns at or near the site. English ships of the estimated class carried nines and threes, not nines and fours. In addition, three pounders of the period were 4 ft.-six inches long, not 6 feet long

(Clowes 1898). A doubt should be forming that perhaps the guns are not English?

Armstrong established rigid measurements for English cannon and Muller in his *Treatise of Artillery* states that English guns of 1757 were constructed to Armstrong's general measurements. The length of the piece was to be taken from the base ring to the tip of the muzzle. This length was divided into seven equal parts. The first reinforce was two parts long, the second reinforce one part long plus one bore diameter (caliber) and the chase measured four parts minus one caliber. Trunnions were one caliber long and one caliber in diameter and they were situated in such a manner that the centerline of the trunnions coincided with the lower line of the bore. Trunnions were placed 3/7 of the length of the gun forward of the base ring. The length of the cascabel was "always" two and one quarter calibers long measured from the base ring to the tip of the cascabel button. Muller says that these dimensions were employed generally by all nations. However, French trunnions were placed one-half caliber "further backward" (3/7 L minus 1/2 caliber).

As mentioned previously, no coral was removed from the Cozumel guns. Therefore it was quite difficult to obtain detailed information concerning the cannon. Except for one gun muzzle, mouldings were not definable and style and shape of cascabel and reinforce mouldings were not easily discernable. Measurements for reinforce spacing are incomplete due to the coral growth. Gathering of this data has been left for a future investigation of the site.

Trunnions of the Cozumel cannon are approximately one caliber long and a caliber in diameter. Trunnions are placed at 0.428 L (3/7 of the gun's length from the base ring). Two hundred sixty-two centimeters (8'-7") looks like a good estimate for the length of the larger guns and 184+ centimeters (6+) is a reasonable estimate for the length of the smaller cannon. Bore diameters are about 4.2 inches (10.7 cm) and about 3.3 inches (8.4 cm), respectively.

Bore diameters coincide with those established for eight or nine pounder and four pounder cannon of the eighteenth century. The lengths of the guns 8'-7" and 6' plus do not correspond with the lengths for the English calibers as established. Furthermore, an English ship should have nine and three pounders in lieu of nines and fours. Whether the larger guns are eights or nines has not been determined. However, referring to R.W. Adye's *Bombardier and Pocket Gunnery* (1804), one can see that the Spanish used nine pounders, 4.20 inches diameter bore, and that there were differences in calibers among the various nations for a given pounder. British nine pounders also had a 4.20 inch diameter bore. French eight pound bores were 4.18 inches in diameter.

English four pounder bore diameter was 3.20 inches. Bore diameter for French four pounders was 3.315 English inches, three pounders 3.011 inches, two pounder 2.631 inches and one pounder 2.088 inches. French one pounder shot size was 2.013 inches diameter and four pounder shot size was 3.196 inches diameter. Due to differences in the French and English pounds, a French eight pounder weighed about 9.3 English pounds. Therefore, a French eight pounder iron ball was only slightly larger in diameter than an English nine pounder ball. Hence a continental European eight pounder ball could be used in an English nine pounder cannon and the converse was also applicable.

Harold L. Peterson (*Round Shot and Rammer*, 1969) states that Spanish artillery of the eighteenth century closely resembled French artillery. However, he says that if a Spanish piece were divided into six equal parts from the base ring to the muzzle mouldings, the first reinforce would equal two parts, the second reinforce one part, and the chase would be three parts in length. He proposes that the long first reinforce, short second reinforce, and a chase only as long as the sum of the other two reinforces is characteristic of Spanish guns. Peterson mentions that some Spanish iron cannon look almost English having general English silhouettes, but the mouldings are just slightly "un-English." He also mentions that Muller's *Treastise of Artillery* was translated into Spanish and seems to have been influential regarding Spanish cannon design.

I should mention here that continental European cannon cascabels appear to have been only two calibers long in lieu of two and one quarter calibers for English cascabels.

Cascabels of the Cozumel guns average 20 centimeters for the nine pounders and the four pounder cascabel measures about 16 centimeters. They are most likely two calibers long rather than two and one quarter calibers long. Measured reinforce spacing of the Cozumel cannon is rough but seems to lean toward H.L. Peterson's description of Spanish artillery for the larger pieces. First reinforce is about 88 centimeters, second reinforce about 44 centimeters, and the chase about 130 centimeters. Similar results were obtained for the smaller cannon (52 cm, 30 cm, 102 cm). The trunnion position and length of chase for this gun appears to be in approximate accordance with Vallieré design (French 1732 regulation).

Guns became quite shorter for a given caliber after the 1780's largely due to the work of Gribeauval. Others, prior to this time, had suggested shorter cannon but French and perhaps Spanish cannon remained quite long until Gribeauval's ideas took hold. As a result of Robbin's and Muller's work, English artillery was shortened beginning after the 1743 establishment. For example, English nine pounders were 7'-0" long during the 1750's. French cannon (Vallieré, 1732) were longer than most guns until Gribeauval (1765) revolutionized French artillery. Vallieré guns of eight pounder size were 24 calibers long. That is to say, a French eight pounder of 10.62 centimeters bore diameter was about 255 centimeters long. By contrast, English nine pounders for ships were 20 calibers long and were only 214 centimeters in length. After the 1780's, nine pounders for most nations were a mere 5 feet long while the bore diameter held as before.

The Punta Salis cannon are about 24 calibers long and clearly were cast prior to the 1780's. Although the British establishments of 1743 and 1764 list nine pounders which were 8'-6" in length, 7'-0" was the length normally used by the British Navy.

It appears as though the Punta Salis ship had long guns in lieu of short cannon and were closer to French lengths for the given caliber than English lengths. One muzzle which was clean enough to view the muzzle mouldings appeared to be Swedish or Spanish in style. The cleaned bore diameter measured just shy of 11.0 centimeters. After selected guns have been cleaned and preserved through conservation, exact measurements of bore diameters may be obtained. It is possible that these measurements could be utilized to determine if the calibers are continental European or English.

Summary

More work needs to be done regarding the guns of Punta Salis before concrete evidence can be gathered concerning nationality of the cannon. The four pounder and one of the "nine" pounders will have to be cleaned and conserved in place or at a laboratory so additional measurements may be obtained. Reinforce spacing, reinforce, muzzle and cascabel moulding styles, exact bore diameter, and other measurements of cannon are among the additional data which should be obtained. Preliminary data appears to tend toward the guns being of a nationality other than English, perhaps Spanish or Swedish. The "nine" pounders, 262 centimeters long, are of greater length than mid eighteenth century French naval short eight pounders (243 cm) and the four pounder is somewhat shorter than French long four pounders (195 cm). French eight pounders (long)

were over nine feet in length (Louis de Tousard, 1809). The four pounder seems to be of a length very close to that of a British four pounder. However, reinforce spacing for both gun sizes appears to be continental European rather than English. The guns are probably for a Spanish ship.

The size of the ship may be estimated to be about 115 feet in length and 32 feet in beam from the number and caliber of guns at the site. She was probably a ship of 18 to 28 guns. Certain artifacts found not only help to date the disaster but reveal that they are continental European in style and that they were made in continental Europe or perhaps Spanish America. I look forward to the continued investigation of this Cozumel site in a united effort with INA and INAH to gather additional valuable data concerning mid-eighteenth century trends and styles of merchandise as well as artillery design of the period. It would be interesting to determine exactly how much Spanish artillery design was influenced by the French and John Muller in the mid 1700's.

REFERENCES

ADYE, R.W.
1804 *Bombardier and Pocket Gunnery*. E. Larkin, No. 47, Cornhill, Boston.

CLOWES, W.L.
1898 *The Royal Navy*. S. Low, Marston and Co., Ltd., London.

MULLER, JOHN
1757 *A Treastise of Artillery*. J. Millan, London.

PETERSON, H.L.
1969 *Roundshot and Rammers*. Stackpole Books, Harrisburg, PA.

TOUSARD, LOUIS de
1809 *American Artillerist's Companion*. C. and A. Conrad and Co.

PETER C. ZWICK
519 THE ARCADE
420 SUPERIOR AVENUE
CLEVELAND, OHIO 44114

ARTHER B. COHN

Underwater Research on Lake Champlain

Although the title of this paper is "Underwater Research on Lake Champlain", I would like to broaden the perspective to encompass other inland lakes, ponds, and rivers, as some of my general comments may be relevant to these waterways. Collectively, inland aquatic environments hold a great legacy of pre-historic and historic materials with potential to add significant new information to the record of human events. Lake Champlain may be the best example of just how rich these inland water are.

Beginning over twelve thousand years ago, Native American's hunted, fished and navigated on Lake Champlain and its tributaries in birch bark and dug out canoes. In 1609, Samual de Champlain was brought to the lake by his Indian allies, and the clock of western history began to run. Strategically set at the fringes of two expanding Colonial empires, the first century and a half was one of violence and warfare as England and France fought to possess the Champlain Valley. At stake was the 120 mile long, navigable north-south highway, and a Valley filled with rich resources, including vast quantities of ship quality timber. After years of bloody struggle, and the building of the first of three naval fleets that would fight for control of the lake, the English in 1759 were successful. For fifteen years settlement and land disputes dominated the region, until in 1775 the American Revolution broke out and used the Champlain Valley as a major theater of the conflict. This period saw the second set of naval squadrons constructed on the lake, meeting in the Battle of Valcour Island in October of 1776. Historians credit this battle, with influencing the very outcome of the Revolution.

After the war, settlement in the Valley began in earnest and the lake took on a more active maritime character as log rafts, commercial lake sloops, and sail and horse ferries began to move people and goods throughout the lake. The lake's first steamboat, the *Vermont I* was launched in 1808, just a year after Fulton's *Clermont* Commerce was interrupted for Lake Champlain's third naval contest during the War of 1812. The Battle of Plattsburg Bay was a decisive victory for the Americans, and was a key to the successful conclusion of the wider military conflict. After this war, canal proponents were successful in building a sixty-three mile "Northern Canal" to connect Lake Champlain to the waters of the Hudson River. With an all water route to New York City the lakes commercial fortunes rapidly expanded. Increased commerce translated into a tremendous increase in watercraft, as traditional sloops and schooners, larger and more elaborate steamboats, and new classes of canal boats were produced. This prosperity continued and by the middle of the 19th century Burlington Vermont was the third largest lumber port in the world.

A new form of transportation changed all that, and the coming of the railroads spelled a steady decline for the lakes commercial fleet. As the lake entered the 20th century, its character was changing from commercial to recreational, a change that is still in full swing today.

As with any maritime environment the presence of ships guarantees the presence of shipwrecks. Lake Champlain and other fresh water environments have the advantage of a relatively stable environment for these fragile wooden time capsules, and a vast collection of shipwrecks spanning all historic periods has been found. Many of the shallow water shipwrecks were removed from the lake during the 19th and early 20th century. The removal was often motivated by high ideals, but the result was almost always the same-the destruction of the resource. One notable exception is the Revolutionary gunboat *Philadelphia*, raised in 1934 by Col. Lorenzo Hagglund, which now resides at the Smithsonian Institution. The rule is represented by this colonial era vessel, the *Duke of Cumberland*. Built by the English in 1759. It was raised in 1909, put on public display, and in 1983, was located rotted in an overgrown woods.

Archaeologist, historians, divers, public administrators and treasure salvors come and go, but the potential informational value of these shipwrecks can live forever. We have a responsibility to the public and future generations to be trustees and caretakers of this record of information.

The States, many of whom have historic preservation statutes granting them "Ownership of Title" to submerged properties, have a responsibility to establish a management strategy that is not just reactive in nature, and ultimately protects the finite resource base. The situation is not static. The advent of sport diving and the improvements to electronic sensing devices, has put previously undisturbed shipwrecks at the hands of the diving public. Selection

of a management strategy must balance off divers rights, and the public rights, but ultimate consideration must be given to the long term "rights" of the resource itself.

This process involves compromise, and in the State of Vermont we have adopted a basic distinction between individual isolated artifacts, which may be taken by the diver, and intact shipwrecks or other integrated underwater sites, whose informational value dictates that they shall be dealt with in a more formal process. To effect this compromise involved a great effort at diver, administrator and public education, adoption of a permit system and guidelines for excavation of shipwrecks, and perhaps most importantly, adopting an attitude of mutual respect. Thus far the program has paid high dividends.

In 1980, our group began studying historical shipwrecks. Lacking large funds or facilities, we adopted an operational bias of leaving everything in-situ, unless there was an overwhelming reason to raise it, and, conservation and exhibit facilities were already in place to care for the items. To date we have raised no hulls and only limited artifact collections which met the stated criteria. Our primary source of funding for the first five years came from matching grants from the Department of Interior, National Park Service, Survey and Planning Sub-Grants program. These funds were administered by the State of Vermont, Division for Historic Preservation, and issued to the Champlain Maritime Society, a private, non-profit organization made up of divers, historians and archaeologists. From 1980-1985 the Federal government gave the underwater program a total of $107,000 matched by an in-kind contribution of $153,000. In 1986 these funds disappeared and according to Vermont State Archaeologist Giovannia Peebles, there is no current prospect for their return. The following is a summary of work accomplished under this system.

Our first project was the study of the steamboat *Phoenix* (Figure1). Built in 1814, the *Phoenix* is believed to be the oldest surviving steamboat hull in the world. She burned in a violent conflagration in 1819 in which six lives were lost, and eventually came to rest on a rocky reef in the middle of Lake Champlain in 60-110 feet of water. Our project produced a wreck site plan, historical documentation and publication of results. Over the next several years we instituted a program of systematic inventorying of the States underwater resources, and the documentation of selected sites. We found a total of four, and have fully documented two forgotten American watercraft known as sailing-canal boats (Figure 2). We have located the Revolutionary war row-galley which served as Benedict Arnold's flagship during the Battle of Valcour Island, and a Revolutionary war bridge that spanned the Lake at Fort Ticonderoga. One crew has located and produced a photomosaic of a rare horse-powered ferry.

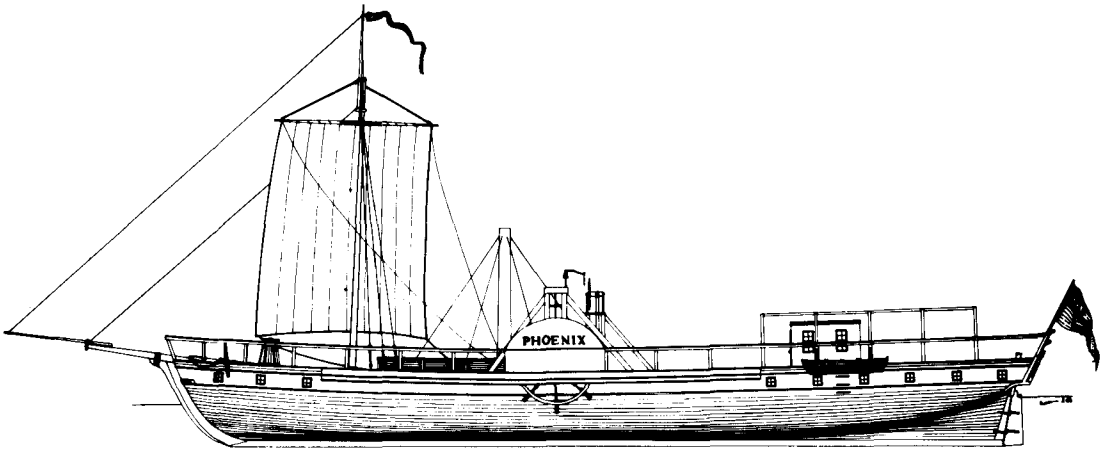


FIGURE 1. Lake Champlain Transportation Company steamer *Phoenix* which plyed the lake for four years until destroyed by fire in 1819. The drawing is based upon archaeological measurements of the hull and contemporary plans of similar steamers.

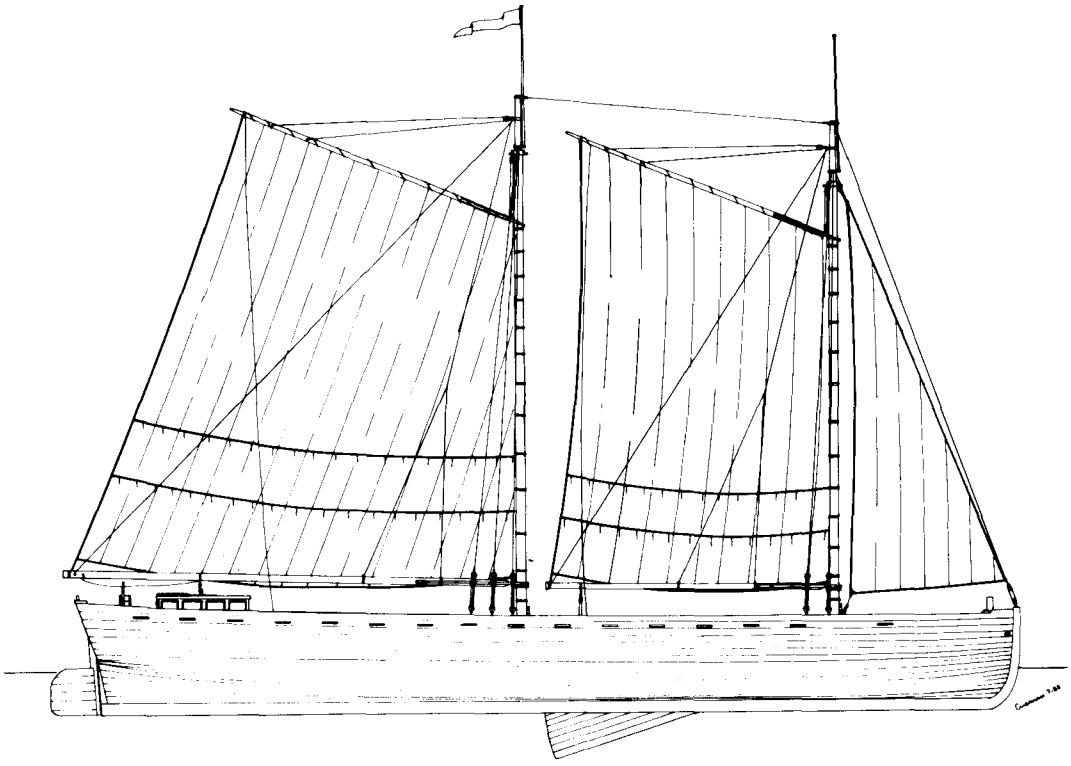


FIGURE 2. The canal schooner *General Butler.* A retractable center board and folding masts permitted her to pass through the narrow locks of the Champlain Canal

Our crew has located three survivors of the War of 1812 fleet and in 1982 and 1983 we spent a total of five weeks in the murky waters of southern Lake Champlain completely documenting the 120 foot, 20 gun brig, the *Eagle* (Figure 3). The project has led to full scale reconstruction plans of the vessel being drafted by our program archaeologist, Kevin Crisman. This project was the subject of Kevins masters thesis at Texas A&M, and is scheduled to be released for publication in May of 1987. The study of this vessel has led us to another inland lake, at Sacketts Harbor on Lake Ontario, where we are currently studying another War of 1812 twenty-gun brig built on that inland waterway under grants from the New York State Office of Parks, Recreation and Historic Preservation and National Geographic Society.

Perhaps our most ambitious project to date has involved the completed excavation and study of one of three colonial era warship hulls located off of Fort Ticonderoga. This project brought together several diverse organizations in a creative project arrangement. The hull of the eighteen gun sloop *Boscawen* was located just 50 yards off the Fort Ticonderoga shore, and by statute was the property of New York State. The research proposal had the State of New York retain ownership of the hull and the artifacts collection. Fort Ticonderoga, a private-family operated-historic site, agreed to fund the excavation and become the long-term custodian and exhibit facility of the artifact collection. The *Boscawen* was excavated during a total of eleven weeks over two field seasons and a formal analysis of the hull, artifacts, and history is being completed (Figure 4) in 1985 an interim report of findings was published in the Bulletin of the Fort Ticonderoga Museum.

Our group has been able to work underwater for literally thousands of hours with an extremely high rate of data recovery and a perfect safety record. I would like to think this is because we chose highly qualified people who are advanced or better divers and who possess archaeological skills. It is my opinion that some scientists and project managers do not give enough weight to the technical diving aspects of their program. The better the divers and dive procedures, the greater the efficiency and accuracy of the data recovery, and the safer the project.

I must single out for recognition, Kevin Crisman, our nautical archaeologist and co-producer of the work you have just reviewed. A qualified archaeologist who can control data recovery and transform raw data into information is essential to any management structure. The four line drawing portraits in this article were produced by Kevin.

To conclude, I would like to discuss a new program instituted on Lake Champlain by the State of Vermont in 1985. It is the Underwater Historic Preserve System. Selecting three fully documented shipwrecks, including the *Phoenix* discussed earlier, the State has established moorings to facilitate diver visits to these sites. Divers tie up at surface moorings, descend down the mooring chain to the concrete anchor pad, and follow a yellow travel line to the wreck. Here they are greeted with an underwater sign explaining the shipwreck, and asking for their cooperation in diving safely and treating the site responsibly.

By establishing this program the State has reaped a variety of benefits. It is unreasonable to ban divers from diving on underwater shipwrecks, and the mooring systems prevent anchor damage and

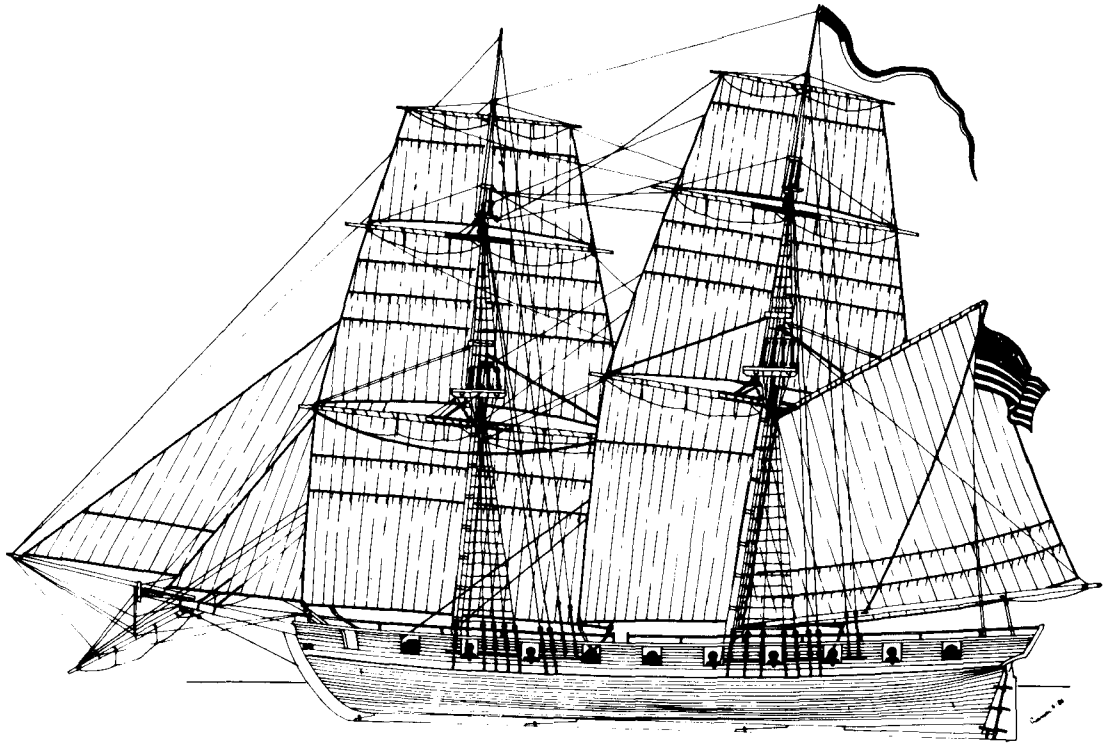


FIGURE 3. U.S. Navy brig *Eagle*. Exactly one month after launching the *Eagle* fought in the Battle of Plattsburgh Bay, contributing to the decisive American victory.

promote diver safety. The Preserve serves as a program of public interpretation, and as a potential tourist attraction. Perhaps its greatest benefit is that it promotes diver responsibility. In the two years that the program has been in effect, it has seen literally thousands of divers visit the sites with no acts of vandalism.

While this is true on the Vermont side, across the lake in New York waters, we have the case of a standard-canal boat who's windlass was photographed in 1985. When photographed again in 1986, the windlass was gone. We believe the "gentle formality" of the Underwater Preserve program creates a spirit of cooperation and responsibility in divers, and it is a low cost effort.

Pre-planning and complete installation of five mooring systems and production of accompanying literatures and first years operation cost less than $15,000. The program presently operates on an annual budget of $5000.

With the collapse of the Federal funds in 1986, we have begun to explore new avenues of funding. A new Maritime Museum established at Basin Harbor, has begun to focus public attention on the lakes rich heritage and begun to act as a non-profit vehicle for attracting funds from private sources. The outlook for our program is bright because we have a resource base that is important and interesting, and a group of talented people dedicated to their responsible study. There are no magic formulas for success and we have certainly experienced the setbacks and problems that are endemic to any complex endeavor. However, by making the shipwrecks a party in interest, and giving them an elevated position while balancing the public's right to access, we have found a mutually beneficial ground upon which the divers and the State can cooperate; to the benefit of each other and the underwater resources.

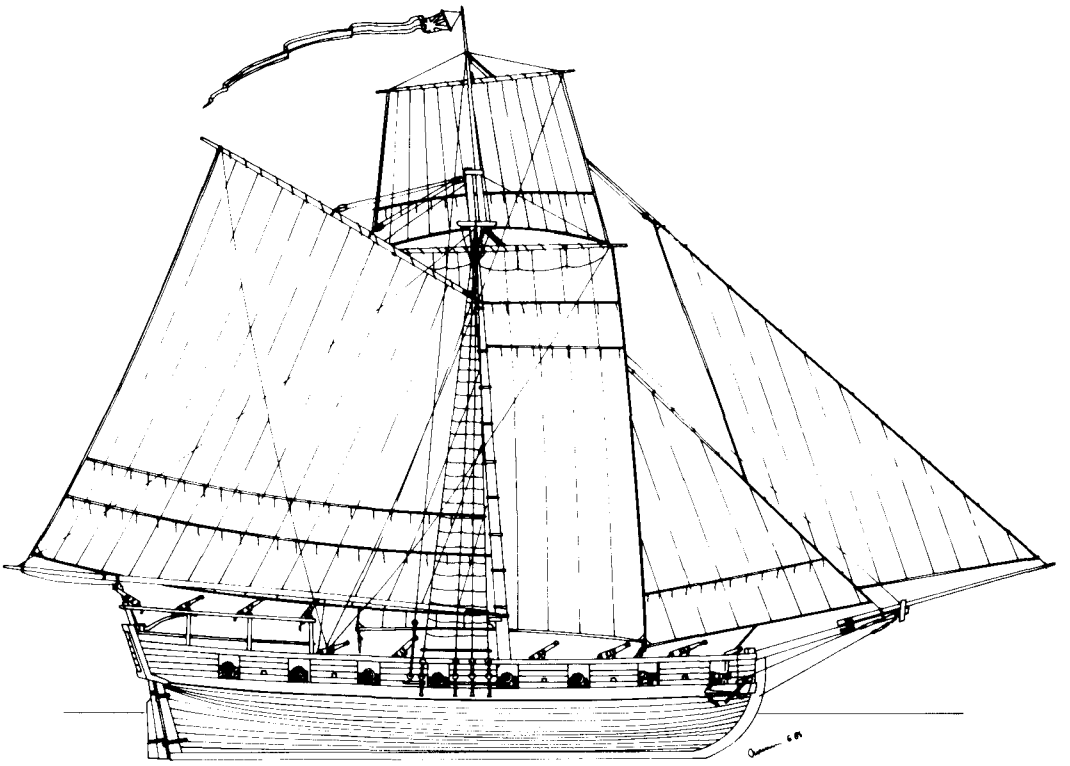


FIGURE 4. British 16 gun sloop *Boscawen*. This conjectural drawing is based upon archaeological measurements of the sunken hull, and upon contemporary paintings of the sloop.

ARTHUR B. COHN
BASIN HARBOR MARITIME MUSEUM
VERGENNES, VT 05491

ANNE G. GIESECKE

Creative Financing and Project Management

The public coffers are nearly empty. Reaganomics has taken its toll on public funding, and cultural resource projects have been hit hard. The goal of this article is to review some of the funding sources available for underwater projects. Money is available from profit, not-for-profit, and publicly affiliated organizations.

At the same time that federal and state funding programs have been cut, the demand on shipwreck resources has increased. Change is very rapid these days especially near water. The better our technology, the more development and the more of our past that is revealed during excavation of the banks of rivers and the bottoms of harbors. We can see lost towns of colonial America and the lost ships of the Spanish empire. As those treasures of our past are presented to us, we hunger for even more.

The past plays an important part in the present. We use the past as an orientation to our own lives. Where did we come from? Why are we here now? We use the past as a justification for our own lives. Our family has always lived on this farm or we have always pierced our ears. As a nation, we select the parts of the past that will teach our children the image that we have of what is America. In the present we choose to keep or destroy pieces of the past, and consequently, we control what part the past plays in our children's future.

Of the more than 12,000 known shipwrecks in the U.S. waters only about 5% are probably historic, that is, have a story to tell about our past. Special care is required to excavate these wrecks and get the story. Both profit and not-for-profit operations have excavated historic shipwrecks. One important point to remember, however, is that profit or not, all the money comes from some profit making enterprise.

Operations hoping to make a profit excavating shipwrecks are often structured as limited partnerships. These operations have been characterized by less than 24 shareholders investing less than $100,000 each. The government does not require these companies to make public disclosure statements. However, in the last couple of years, the millions of dollars required to look for and excavate some historic shipwrecks have required these companies to go public. None of these companies has shown a profit, although a few investors, on one occasion, have gotten a positive return on their investments.

Currently, profit operations are working with state permits in the waters of Florida, South Carolina, Massachussetts, Delaware, the Northern Mariana Islands and Guam. Changing tax laws, environmental laws and increasing regulations will mean that profit operations will have to continue to adapt if they are to survive at all.

Two federal funding sources that have awarded money to not-for-profit groups are the National Science Foundation and The National Endowment for the Humanities. The National Science Foundation has funded work by George Bass in the Aegean Sea on wrecks dating back 3,000 years. The National Endowment for the Humanities has funded work by John Broadwater in the James River, Virginia on Revolutionary War wrecks. These agencies require that professional archaeologists head the projects and that the data collected on the shipwreck be used to answer research questions about the past.

State Endowment for the Humanities programs and State Historic Preservation Offices also have made grant funds available for shipwreck projects with similar requirements for archaeologists and research questions.

As stated earlier, federal and state sources have less money to distribute now than they have had in the past. The result has been a number of important private sector initiatives. One of the most successful ways to finance the excavation of historic shipwrecks and recover the archaeological data necessary to tell the ship's story has been participant funding.

The best example of participant funding is the Center for Field Research and its affiliate Earthwatch. These are not-for-profit organizations which seek to increase public understanding and support of field research in the sciences and humanities. The Center receives proposals, conducts in-house and independent peer review, and recommends proposals to Earthwatch for support via participant funding wherein qualified amateur volunteers who pay a share of the project's costs are recruited to assist in the gathering of field data.

Earthwatch is now the third largest source of private funds for research and will contribute $1.8 million to over 100 research projects in 1987. Earthwatch and the Center have supported some 20 underwater archaeology projects since 1971. According to Brian Rosborough of the Center, "Volunteer field workers have responded enthusiastically to underwater archaeology projects. In addition to the obvious value of extra hands in the field, the financial, educational, and public relations benefits of participant funding have been well established by the success of the Center and Earthwatch."

On a somewhat smaller scale, but no less important, are joint effort projects by enthusiastic individuals. A significant example is the 1986 project by Peter Zwick on the late 18th century Punta Salis Shipwreck, Cozumel Island, Mexican Caribbean Sea.

The list of contributors is impressive. The Institute of Nautical Archaeology, Mexico, Pilar Luna, provided funds for food, drink, and equipment. Aqua Safari Dive Shop, Cozumel, Bill Horn provided the boat, pilot, and scuba tanks. The Institute of Nautical Archaeology, Texas, Joe Simmons provided expertise and equipment. All participants paid their own expenses to and from Cozumel. Rick and Marie Franz Hajovsky and Genevieve and Dan Hartman provided housing. Peter and Joyce Zwick provided the Theodolite.

Peter Zwick states, "In my opinion, the most important part of the project was the great cooperation among the participants. The group worked as a team. Discussions and the partaking of meals together in the evening being the standard course of events. I believe this cohesiveness was the main factor in the large quantities of work performed in the rather short five actual work days at the site."

Another approach to financing projects has been the organization of sport diving/historical societies. Three will be described here: the Champlain Maritime Society, Save Ontario Shipwrecks, and the Underwater Archaeological Society of British Columbia.

The Champlain Maritime Society is based in Vermont. The state of Vermont has a legislative mandate to preserve, protect and interpret the State's underwater historic resources. The State lacked the personnel and budget to implement the program. The Champlain Maritime Society, a private not-for-profit tax exempt corporation has, in cooperation with the Division of Historic Preservation, carried out the underwater research program of the state of Vermont. The organization is composed of historians, divers, archaeologists and interested maritime persons. The Society is funded through membership fees, state grants, and donations.

Over the past seven years the Society has engaged in an impressive series of projects and produced several publications. "However," says Arthur Cohn, a member of the Society, "in 1986, federal cutbacks threatened to cancel plans for field work. This situation has made the debate about funding and management critical."

Fred Gregory, President of Save Ontario Shipwrecks (SOS), re-

ports that SOS was incorporated in 1981 with aims to further public knowledge and appreciation of Ontario's maritime heritage. They do this through assisting museums and archives in gathering historical information and artifacts, by educating the general and diving public, and by encouraging divers to survey, document, and preserve shipwrecks in Ontario's lakes and rivers.

Volunteers rely on their own resources. They use their own equipment, vehicles and boats, and locally manufacture any necessary equipment. In addition to membership fees, government grants, donations of goods and services from local businesses, fund raising activities, such as T-shirt sales and treasure hunts, have helped.

Further west, in 1975 a group of concerned individuals founded the Underwater Archaeological Society of British Columbia, a not-for-profit organization dedicated to promoting an interest in the science of underwater archaeology and to conserving, preserving and protecting the maritime heritage of the Province that lies beneath the coastal and inland waters. According to David Griffiths, Executive Director, the Society has undertaken over 100 survey and mapping projects.

Griffiths states that, "To date the Society has operated on small grants, membership dues and donations of time, equipment and services by interested individuals, agencies and businesses. Next to the panhandlers in downtown Vancouver, the Society members have become the most expert scroungers on the coast. The scourge of every businessman, politician and equipment supplier in British Columbia."

Martin Klein of Klein Associates, Inc., makers of side-scan sonar equipment, has donated countless hours and sent his equipment all over the world on volunteer projects. Klein comments, "We are more than glad to lend our equipment and participate in exciting projects but it would be nice if someone said thank you." Businessmen are in business to make money. They are interested in sales and advertising. An acknowledgement in a report or a letter to hang on the wall could make a major difference in the working relationship between a group and a company.

The groups and projects that have been most successful have been those that understand and carefully market their product. There are some important questions that you should ask about your project before you ask for support.

1. What is your product? Is it research, education, recreation, increased tourism, economic profit?
2. How is your project priced compared with comparable projects or products? Are you competing with museums or amusement parks?
3. Does the project fit with the objectives, program, and structure of your organization? That is, will you be able to actually do what your propose?
4. What product (research, education, etc.) goes back to the participant, individual, business or community that helped?

Finally, private sector initiatives like those introduced here are finding the resources and making significant contributions to the study of maritime history. To continue to be successful, organizations will have to be accountable for the materials and services they receive. Reports must be written, popular articles published and thank-yous sent to acknowledge everyone's contribution. Participant funding and projects have a far greater potential for direct benefit than dependence on taxes collected and then given out as grants by state and federal governments.

ANNE GIESECKE
1001 WILSON BOULEVARD
ARLINGTON, VA 22209

SYMPOSIUM

J. Barto Arnold III,
Larry V. Nordby,

The Padre Island Archaeological Survey for 1986

Introduction

Padre Island National Seashore consists of a narrow barrier island about 128 kilometers long, and ranges between .5 and 3 kilometers wide, extending from Corpus Christi on the north, to the Mansfield Channel, opposite Port Mansfield, on the south. Between the island and the mainland Texas coast lies the Laguna Madre, a brackish, marshy basin with minimal tidal changes. On the seaward side of the Island, a gently sloping beach and ocean bottom extends well out beneath the waters of the Gulf of Mexico. This gently sloping sand bottom, a series of three longshore bars, and incessant surf combine to create a difficult survey corridor that runs parallel to the long axis of the Island. The jurisdiction of the National Park Service extends to the two-fathom or 12-foot bathymetric contour, averaging 400 meters offshore. The State of Texas jurisdiction extends seaward from that 12-foot contour.

In managing the cultural resource components of Padre Island, the National Park Service's primary goal is resource location, coupled with preliminary evaluation. The methodological structure is generally known to all and to Padre Island has been implemented as a series of steps. At this point we will outline these steps, returning to flesh out the skeleton later.

Step 1 consists of literature and background research, including consultation of the Texas Antiquities Committee (TAC) shipwreck site files. This effort was initiated by Nordby and Murphy (1984) during preparation of the Park Service's request-for-proposals and continued under contract by New World Research, Inc., and OSM Archaeological Con sultants, Inc. The end product of step 1 is a list of wrecks known or strongly suspected to be in the study area, as well as a better understanding of the cultural and historical factors that led to their disposition and distribution. This list was produced during 1984.

Step 2 is composed of a remote sensing survey of the sandy Padre Island Gulf sea coast based on one of several methodological schemes. The method selected is an extension of the findings of the background research. The product is a preliminary report, along with recommendations for executing step 3. This was completed during 1985.

Step 3 is largely synonymous with anomaly evaluation or a preliminary examination of visible wreck sites in an attempt to establish shipwreck identity or discern other factors such as vessel type, period, function, etc. Anomaly investigation was carried out during 1986. A key component of National Park Service surveys is recommending to area managers the strategy appropriate for managing each individual wreck. The product is a final archaeological survey report, with recommendations for intensive site-specific studies.

Step 4 ordinarily follows a separate funding request and is beyond the scope of this project, focusing on site-specific study, research, or intensive evaluation. The product is a site report that conveys the research results that emanate from excavation or other research.

We presented the results of the background research in our paper of last year (Nordby and Arnold 1985). In the same paper we discussed the extension of the original TAC magnetometry survey from its terminus at 12 miles north of the Mansfield Cut to a point about 20 miles above the Cut (Figure 1).

The total numbers of anomalies for each of the classes shown below in Table 1 indicate the overall character of magnetic readings encountered in these four blocks. There were many small anomalies, but only 4-5 of greater than 30 gammas:

3-4	gammas: n	100
5-10	gammas: n	60
11-20	gammas: n	20
21-30	gammas: n	10
31-100	gammas: n	3
100	gammas: n	1

As a standard analytical technique, the anomalies were grouped into clusters following an analysis of spatial distribution and examination of the Geometrics 866 strip charts. Of great interest in making subsequent decisions on further investigation were number of hits in a cluster, and the size of the largest hits. Results were a series of 16 anomoly clusters. In an environment that could be expected to produce at least a modicum of noise, this left us with very few areas to test especiallly since the largest anomoly in many clusters was generally less than 25 gammas and frequently less than 10 gammas.

As a complementary strategy, we also re-analyzed the earlier mag data and selected small anomalies along the inshore edge of the TAC survey blocks from 1974 and 1975 (Arnold 1976). Similarly, most were small and had been deemed of low priority by TAC, but since they lie within NPS waters we wanted to identify any possible resources for management purposes. Further work at one anomaly previously tested by TAC (41KN16) was also a top priority since the site dated to the 1554 incident.

1986 Magnetometer Survey and Test Excavation Methodology

During the 1986 season we utilized two vessels, one a small, fast, rented boat for the magnetometer survey work of relocating and buoying anomalies and the larger TAC vessel *Anomaly* equipped with a prop wash deflector or blower for the underwater test excavation and diving. The mag survey boat was a 26' sport fisherman with a fiberglass hull and tunnel drive ideal for work in shallow water. The boat was magnetically quiet enough to boom the land mag sensor of the Geometrics 806 off the bow. This configuration is much more convenient than a towed sensor. Buoy drops are also more precise since the boat can be stopped, maneuvered, and even backed without fear of cutting a towed sensor cable.

The shallow water feature proved particularly important because we hoped to extend the earlier TAC mag survey coverage further inshore in the area of 41KN16 and 41KN10 (*San Esteban*) than had been possible on the original survey conducted from the *Anomaly*. As luck would have it, we hit one of those extraordinarily rare calm days. There was virtually no surf at all. On a normal day there are at least two rows of breakers, changing to three or four as the winds pick up after noon. Amazingly, we could survey on tracks parallel to the beach in as close as 30 meters from the beach. The earlier survey had stopped about 250 meters from the beach. In nine seasons of work off Padre Island the senior author has seen the seas that calm

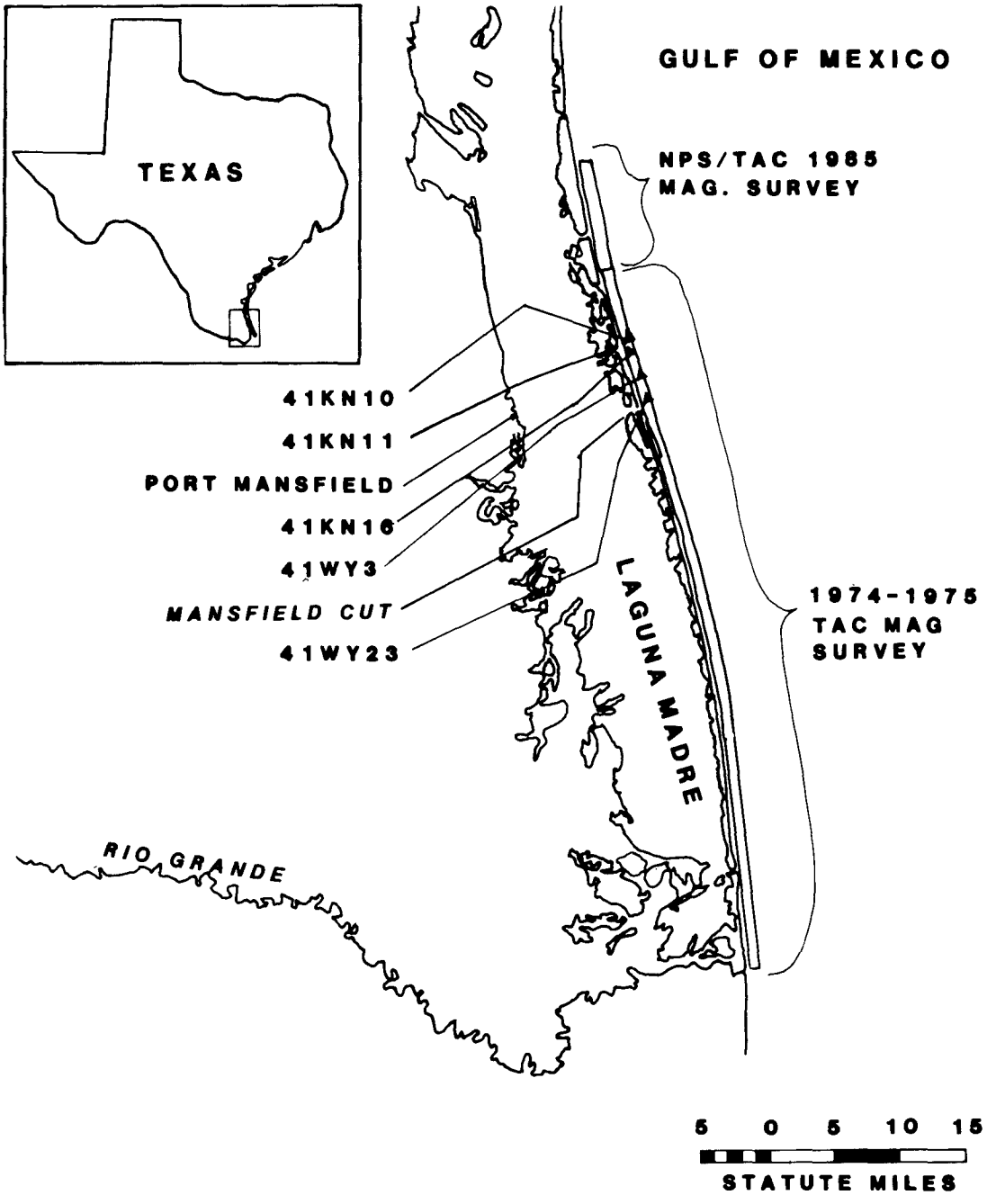


FIGURE 1. Map of research area showing survey area and key archaeological sites

on only three or four occasions.

All clusters containing anomalies from the 1985 survey of 25 gammas or greater were subjected to further investigation by close-grained resurvey with a Geometrics 806 mag. Lane spacing ranged from 5 to 20 meters. This essentially became the end part of a screening process to determine which anomalies or clusters warranted test excavation.

After the anomaly had been relocated and marked by the mag survey boat, *Anomaly* arrived on the scene and, after anchoring, a diver-towed sensor from a Geometrics 866 was used to further pinpoint the anomaly location. A work buoy was then dropped as a visual reference and *Anomaly* was backed into position, a three-point mooring established using a Zodiac as an anchor setter and tender, and her newly redesigned propwash deflector installed.

Test excavation positions were shot in from shore using an EDM, and careful records were kept concerning test pit locations, engine RPM and time logs, and any findings. In previous years, installation of the blower had proven to be a lengthy (45 minute) and occasionally hazardous operation, so *Anomaly* had been retrofitted at a shipyard with a new installation device designed by Larry Murphy. Installation time was subsequently reduced to 5 minutes or less.

As a result of the multistaged screening process prioritizing all clusters, only four anomalies were considered to be worth testing. Only the most brief summary of three of these areas is possible here:

(1) This anomaly, about 30 gammas, was so deeply buried in sediment that the propwash deflector could not keep the hole open long enough to determine the source. No contact was recorded.

(2) This anomaly was a 25 gamma hit that produced an assortment of three artifacts: (1) a piece of threaded-end, 1-inch diameter galvanized pipe, (2) a segment of lightweight chain, and (3) a 30-30 COR-LOKT cartridge. This probably represents a small wreck but dates to the modern era (post-1960).

(3) This anomaly consisted of a large metal tank with welded seams. The tank was about 8 feet long and 2 feet in diameter, possibly a fuel or water tank, probably dating to after 1930, based on the presence of the welded seam. No other anomalies could be identified near the test site.

The final testing was conducted at 41KN16. Most of the remainder of the paper concerns this work, which produced the summer's most important findings other than the negative evidence that there are no significant wreck sites along the portion of the Texas coast surveyed in 1985.

41KN16

Located during the 1974 Texas Antiquities Committee magnetometer survey, the site (41KN16) lies some 300 meters inshore and southwest of 41KN10 the 1554 flota wreck which had been tentatively identified as the San Esteban. The Texas Antiquities Committee conducted a major underwater archaeological excavation at 41KN10 in 1972 and 1973. The proximity to 41KN10 and the inshore location made this anomaly an immediate target of interest. It was assumed that the cause of the anomaly was in some way associated with the nearby flota wreck, perhaps a separate major section of the wreck; alternatively, it was known from the historic salvors that one small vessel was lost by the Spanish salvors in the summer of 1554. The flota ships ran aground and were lost in a storm on April 29. In wrecking, a smaller vessel would be expected to ground closer to the beach. As we shall see in due course, 41KN16 did indeed relate to the Spanish salvage expedition led by Alvarado Garcia de Escalante and Angel de Villafane but in an unexpected way. The two leaders were in their own right important citizens of the Viceroyalty of New Spain (Weddle 1985).

In 1974 and 1975 the Texas Antiquities Committee undertook a major magnetometer survey of an area beginning at the mouth of the Rio Grande and extending up Padre Island to about twelve miles north of the Mansfield Cut. The area included the three 1554 wrecks located at the cut (41WY23), two and a half miles north (41WY3), and five miles north of the cut 41KN10. The purpose of the survey was twofold, to cover the 1554 flota area, picking up any additional anomalies associated with that incident and to generally locate and identify historic shipwrecks in the entire 50 mile long survey area. The anomaly measuring 17 gammas at 41KN16 was recorded on the two survey tracks close to the beach, about 375 meters offshore.=

The first step during test excavations at the site in 1975 was to relocate the anomaly (Arnold 1976). After buoying the anomaly and anchoring the survey vessel we again magged the site by swimming the sensor back and forth on the surface behind the boat. A maximum of 50 gammas was recorded during resurvey. The purpose was to pinpoint the areas of maximum gradient or change in field strength. This, according to theory, is the point directly over the object causing the anomaly (Breiner 1973). The exact spot for a test excavation hole was thus defined in 15 feet of water. In the first test hole we located an anchor conforming in proportions and dimensions to those expected for a large 16th Century Spanish ship's anchor.

This anchor conformed in all details to the other 1554 wreck anchors recovered, including the orientation of the nuts or stock keys protruding in the same plane as the arms, a feature shifted 90 degrees in later times. This particular wrought iron anchor was the largest and heaviest of 11 recovered and recorded from the 1554 wrecks, measuring 4.31 meters in length without the ring, and weighing over 1000 pounds (Arnold and Weddle 1978: Table 1.1, 224-230). It is difficult to imagine how an anchor of this size could have come from 41KN10, the *San Esteban*, when all of the rest of the major, heavy artifacts settled and remained in place at that site. It occurred to us at the time that this anchor was much too large to have been part of the normal ground tackle of the small vessels the Spanish salvors brought to the site.

One possibility considered was that the salvors had recovered the anchor from one of the wrecks and placed it where we found it to provide a small boat anchorage just offshore from their camp. We had recovered artifacts on the surface just behind the dunes opposite this area in 1973 (Arnold and Weddle 1978:205-206). The area had been tentatively identified as the salvors' camp (41KN11) although we were not completely sure that the remains had not washed into the area from the *San Esteban* (41KN10) during major storms. One bit of evidence pointing toward the salvage or survivors' camp idea was that the fist-size ballast stones found were many times larger than the flat, quarter to half-dollar size pebbles often found on the beach near the water. The small pebbles most probably did work in from the wreck.

The tentative identification of 41KN10 as the *San Esteban* was based on somewhat circular reasoning and negative evidence (Arnold and Weddle 1978:326-327). The negative evidence related to the carat finess of the two gold bars recovered (15 1/2 carats from 41WY3 and 15 3/4 carats from 41KN10), which did not match that known (18 carats) bar listed on the only complete cargo manifest for the ships, that of the *Santa Maria de Yciar*. A problem here is that the bars might have been contraband. However, this seems unlikely due to the official stamps and apparent assayer's bite on one end. So the

Santa Maria de Yciar could tentatively be discounted as the identification of 41KN10 or 41WY3. This makes 41WY23, the southernmost of the three, located at the Mansfield Cut, the *Santa Maria de Yciar*.

From the Spanish salvors' daily account of their activities (McDonald & Arnold 1979) we know that the wrecked hull of the *San Esteban* was the only one of the three still intact and visible above the water when the expedition arrived on July 22, 1554, almost three months after the disaster. It is reasonable to expect that they would set up their camp on shore opposite this wreck. From the records, we know that they salvaged it first. Next they dragged for and located the *Espiritu Santo* and we assume with some confidence that this is 41WY3, the next wreck down the beach to the south, the middle one of the three. We know that later still they dragged for and located the *Santa Maria de Yciar* at a distance of two leagues from the *San Esteban*. Two leagues is very close to the actual distance of five miles. Although the distance from the salvage camp to the wreck was stated, the direction, either south down the beach or north up the beach was not. When the main report on the 41KN10 excavation was published in 1978, the site identification problems were left as follows:

> The only evidence to indicate the *San Esteban* was the northern and not the southern wreck, discounting the gold bars just mentioned, is in the location of the salvage camp, whose probable remains we investigated by surface opposite the northern wreck, and the location of the vessel lost during the salvage expedition's stay, the ship of Vergara. The anchor recovered at a location meters to the southwest and inshore of the northern wreck is probably from the wreck site of Vergara's vessel (Arnold 1976). She was probably anchored off the camp when a sudden squall sent her aground. The last day of work before the storm was August 22nd., and indications are that the day ended uneventfully. The next work day was August 26, and the reference is made to returning to the site of the *Santa Maria de Yciar* even though nothing more could be found on August 22 because it was hoped that the storm that sank Vergara's ship would have uncovered more of the cargo which it had. There is no evidence that a day's work was interrupted by the squall, and it can therefore be assumed that the ship was lost near the camp.
>
> Comparing the collections from 41KN10, the northern wreck, and 41WY3, the middle wreck, one is soon struck with the fact that the middle wreck produced a much more substantial sample of artifacts than the northern one. This is especially evident in the relative number of coins and silver disks and in the numbers of guns, items which the Spanish salvors would have saved if they could. It could well be that this is a function of the middle wreck having been broken up and the hull of the northern wreck, 41KN10, intact as would have been the case if she were the *San Esteban*.
>
> I do not feel that the evidence for identification is definitive, but unless further documentation turns up, it is the best we can do (Arnold and Weddle 1978:327).

There remained a 35 gamma anomaly at 41WY16 after recovery of the anchor during the test excavations of 1975. Also during the testing we located a few scattered items including a sawn board that seemed so fresh that we wondered at the time if it were modern and entered the question in the notes. It seemed possible that since the anchor was accompanied by other artifacts and an anomaly remained that the site might be that of Vergara's lost salvage vessel. The problem was, what would a small vessel be doing with an anchor that size? Had they hauled it over from one of the wrecks? It seemed too big to be part of a small ship's standard equipment. Did they have it on board as salvage? The salvage account officially recorded only salvage items of cargo or personal possessions such as clothing. One can be sure, however, that the sailors of the salvage expedition were also recovering anything else of use in the way of ship's gear. Since this was not being recorded by the royal notary, such salvage of ship's gear may have been an unofficial perquisite of the salvage crew. Alternatively, there may well have been representatives of the ships' owners or surviving officers along to take possession of reusable gear although such participation is not noted in the account.

There were doubts that prevented an unequivocal identification of 41KN10 as the *San Esteban*. The few artifacts collected from the surface behind the dunes might have washed in from the wreck instead of being from the salvor's camp. This was doubtful since the ballast stones found were fist-sized and on the forebeach only small flat pebbles no bigger than a half dollar were found. These smaller stones probably did wash in. For that matter, could this be a survivors' camp instead of a salvors' camp? The documentary evidence indicates that the survivors' stayed in the area only two or three days; whereas, the salvors were there about two months. The survivors' camp would thus be extremely ephemeral and we prefer the hypothesis that the site is the salvors' camp.

To summarize, as to the 1975-1977 site testing:

Hypothesis 1:	The scatter of artifacts in the dunes is the salvors' camp.
Hypothesis 2:	41KN16, the isolated anchor site, has something to do with the salvage expedition. Perhaps it is the site of the wreck of Vergara's barca.
Hypothesis 3:	41KN10 is the *San Esteban*. The reasoning was still a bit circular and in some respects tentative.

There the state of knowledge rested until the 1985-1986 field seasons of the NPS inventory of cultural resources, land and marine, at the Padre Island National Seashore in which the TAC and the Corpus Christi Museum also participated. In 1985, about eight more miles of marine magnetometer survey were added north of the point where the TAC's survey left off. On land, considerable time was spent trying to get a better handle on the presumed salvors' camp (41KN11). Further surface collections netted a few more artifacts. A limited land magnetometer survey did not turn up anything other than some steel pipes from a World War II coastal defense installation located in the same area. Further work is needed to locate possible features such as hearths, wells, trash pits, or possibly even graves of deceased passengers and crew.

Along with the newly located 1985 anomalies scheduled for further investigation there was the anomaly remaining at 41KN16 after the large anchor was removed. This anomaly was also to be tested, and when it was, we found another large wrought iron anchor.

The new anchor had the distinctive proportions of the other 1554 wrought iron anchors (Figure 2). Its position was shot in from shore by traditional EDM and theodolite surveying methods. It was recorded photographically and on video tape and left in place. The position plotted out about 15 meters from the anchor recovered by the TAC. The anchors were both oriented with their rings to the NW as would be the case if used in summer when the prevailing winds are from the SE. They were obviously intentionally placed, thus eliminating the remote possibility of natural transport from the 41KN16 wreck site. The close proximity seems to indicate an anchorage for

small boats with mooring buoys from which it would be easy to cast off and tie up each day. A less likely possibility is that these two anchors were in use by Vergara's barca when she was lost. We know that Escalante was reimbursed "105 pesos ... for certain tools and two anchors ... which he gave for the Armada" (salvage expedition) (Mcdonald and Arnold 1979; 179). These two anchors were probably extras brought along especially for the purpose of establishing an anchorage outside the surf line near the camp. We learned from experience that launching boats of a larger size from the beach in this area was very difficult. We are confident within a reasonable doubt that the two anchors we found are the two for which Escalanate was reimbursed. We can guess why they were lost. After their use as an anchorage for two months they had become buried in the sand. The salvors could not break them free when it was time to leave and therefore were forced to abandon them.

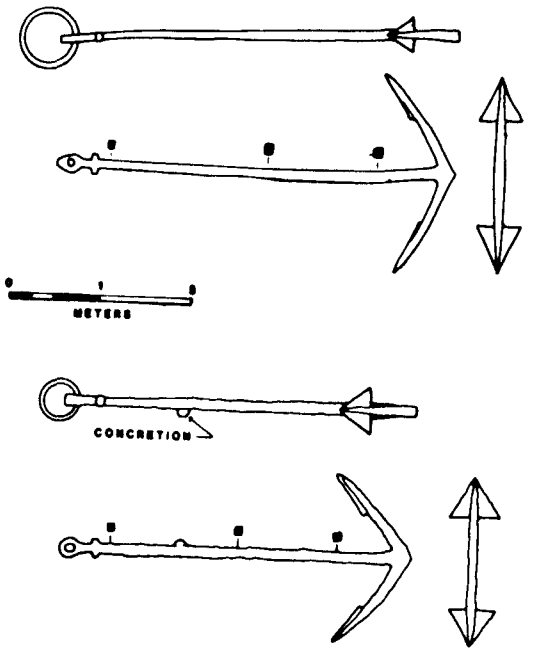


FIGURE 2. Comparative features of the two anchors at MN 10-13a. Upper drawing is the cleaned specimen recovered by T.A.C., and the lower drawing is the uncleaned specimen exposed during 1986. Upper anchor is redrawn after Arnold and Weddle (1978: Figure 110).

If this is the case, then how do we account for the piece of wood that resembles a modern 1" x 4" board? If it is not intrusive, we explain its origin as follows. In the documents, the salvors always described the cargo boxes containing the king's silver in specific terms so that ownership would be established beyond a doubt. One such passage went:

"Also on this day nine boxes were found. Three of them were brought up, one whole and the other two with the bottoms broken. The other six were opened by the divers underwater because they could not bring them up any other way. They brought up the tops from said boxes, and the wood was sawed pine like what they bring to the city of Veracruz from the mountain range of Agua de Perote, from which the lieutenants of His Majesty's officials are wont to make the boxes to carry His Majesty's silver. To the captain, and to me the notary, and to many other persons from Veracruz, these seemed to have the same wood and method of construction as the boxes made in the city of Veracruz for His Majesty, as I have already said. The said boxes were neither tied up nor wrapped; they were not labeled, nor did they have any other sign than what I have just mentioned. In presence of me the notary, the captain ordered this silver placed in different boxes to be weighed" (McDonald and Arnold 1979:161).

It is possible that the water-logged boards form the King's crates were tossed over the side at the mooring site at the end of the day in a general clean-up of the salvage boats. They might well sink to the bottom and be buried in sand along with the mooring anchors. In addition, a second board was found during the test excavations of 1986. This wood was identified as cottonwood by the Laboratory Of Tree Ring Research. In spite of the lack of agreement between the two species and the documents, it remains possible that the wood represents discarded crating.

It is probable that the two anchors were in use as a small boat anchorage because of their close proximity to the associated finds, and since the site of Vergara's barca wreck would have been some distance from its anchor(s) due to the scope of the anchor cable needed for even a small ship. Small boats, on the other hand, in a mooring buoy situation, could be tied up to the buoy, with the buoy itself on a short cable directly above the heavy anchors.

Boats of the Spanish Salvage Expedition

There were several vessels utilized by the expedition sent from Vera Cruz to salvage the 1554 wrecks. We have a detailed account of the salvage efforts which includes this and other information (McDonald and Arnold 1979:148-187). Reference is made to separate vessels called barca, bergantine, bateles, and chalupas. The first two are the names of small types of ships of around 50 tons burden (Palacio 1986). The vessels being salvaged were naos, probably of about twice that size. The barca and bergantine were the main conveyances for the expedition. One ship, the *San Espiritu* owned by Gaspar Diaz, made two round trips to Vera Cruz, for which Diaz was paid 909 pesos during the July 21 - September 11, 1554, run of the salvage expedition, probably for supplies. Fairly commodious ships are indicated by the 14 steers and 130 sheep purchased and transported, probably on the hoof and about forty bushels of corn which formed only a part of the supplies taken to Padre Island, then known as the Medanos de Magdalena, (the Sand Dunes of Magdalena).

The terms barca and the variant barco are both found in nautical vocabularies and there was confusion in the sixteenth century and thereafter regarding the difference intended, if any (Pontillo 1975:147). The reference is definitely to coastal trading vessels. A detailed description of the typical 50 ton barco de trato of the 16th

century Gulf of Mexico coast of New Spain is provided in Palacio (1986:116). They were designed for shallow water and proportioned with the width at the floor equal to 1/2 of the widest beam and 2/3 of the widest beam for the depth of hold. They were two-masted with the main mast equal in length to the keel, the main yard twice the beam and the fore-mast, Palacio says, in proportion. The barcos de trato had flatter floors and less dead-rise than the frigatas of equal burden but sharper proportion which Palacio also describes. A frigata would be 1/6 of the widest beam at the floor and 1/3 of the widest beam for the depth of the hold. The barco was specifically designated to get inshore along the shallow coasts of the Gulf of Mexico. Hernando de Vergara was paid 1836 pesos, 3 tomines for his barco that was wrecked on the 1554 salvage expedition (McDonald and Arnold 1979:179).

The bergantine was a small swift vessel with two square rigged masts and of about 50 tons burden, perhaps more similar to the frigata than the barco de trata in hull proportion (Palacio 1986:161, 247-248). The salvage account mentions that when the expedition returned to Vera Cruz, Garcia de Escalante had Mendoza's barca and the bergantine inspected after off-loading the salvaged cargo. He found over 300 pounds of silver bullion and 600 pesos in coin squirelled away by ne'er-do-wells of the expedition. Aside from the shrewdness of the expedition leader and the unspoken comment on human nature, we can see that two ships were used for the return voyage, and they carried the salvaged treasure which amounted to 64,913 marks (32,456 pounds) in silver bullion and a very small amount of gold bullion and 35,060 pesos in silver coin. This amounted to about half the silver loaded on the three wrecked naos of the 1554 flota The 100 ton flota ships also carried perishable bulk cargo items such as wool, hides, cochineal, and herbs which undoubtedly spoiled and were not mentioned as having been salvaged.

Chalupas and bateles were sent each day from the salvage camp to work the wreck sites. This is specifically stated in the salvage account, and one would assume from this that the larger vessels stayed at anchor off camp. Interestingly, Hernan Rodriguez was paid 40 pesos for two chalupas used on the expedition "for the service of the ships" (McDonald and Arnold 1979:180). This was probably a rental fee since nothing is said of the boats being lost. Palacio (1986:136) says a chalupa (translated as shallop) would be 3/4 the size of a batel (longboat) in length and width making it 12 cubits in length and 4 1/2 in beam. While still strongly built, it would be lighter construction than a longboat. The bateles (longboats) of the expedition would also conform to Palacio's description being, 16 cubits in length, 6 in width, and 2 1/2 in depth. A equaled 21.938 modern English inches (Palacio 1986:199), so a longboat would be about 30' x 11' x 4.57' and chalupa 22' long by 8.23' in beam. These are sizable boats propelled by oar or sail. Palacio (1986:136) specifies, "Any ship has need of a long-boat and shallop also, for its service: whether for setting an anchor, or for recovering it for loading and unloading cargo: for towing, for entering and leaving at any port, bay, or channel, or in a calm; and because, being near another ship, or some shoal, the long-boat could be employed to protect [one's ship] from such." One would assume that the ships of the expedition each came with a batel and a chalupa. Therefore, the two chalupas rented from Hernan Rodriguez were probably laid on as extras in anticipation of a large amount of small boat work during the salvage activities. Indeed Alvarado and Villafane, the co-captains, often were reported workign separately in charge of parties at different wreck sites. Also, while work commenced and continued on the *San Esteban*, whose hulk was visible above water, a batel and chalupa were sent to drag for the submerged hulks of the other two lost ships. A wonderful depiction of this technique was rendered in a treatise on salvage by Pedro de Ledesma published in 1623 (McDonald and Arnold 1979:316-328, Figure 28) (Figure 3). Dragging a wire between two vessels to locate obstructions is a basic hydrographic survey technique to this very day. Upon consideration it is clear that the Spanish salvage expedition was well prepared and astutely lead in the execution of its job.

Conclusions

There are several areas in which we offer some conclusions. First, there are few cultural resources along this shallow water stretch of Padre Island other than those that were already located during TAC work. Debris is of distinctly modern origin. Second, the results of the inshore survey near the salvor's camp were very interesting indeed. There were perhaps a dozen significant anomalies. This number includes one of over one hundred gammas that showed up on two neighboring 20-30 meter spaced tracks. These anomalies very possibly could represent scattered wreckage from the *San Esteban* or further manifestations of the salvors' activities. One is excited by the possibility that the large anomaly might even be the wreck of Vergara's vessel. It is located in a favorable position for that interpretation, to the northwest of the pair of anchors at 41KN16.

Underwater test excavations at these anomalies will be quite a challenge since they are in the surf zone in normal conditions, yet we plan to try during the upcoming summer if weather permits.

Finally, the second anchor found in 1986 was the key piece of evidence that ties down a number of previously tentative interpretations. The two anchors probably used for small boat moorings confirm that the surface scatter behind the dunes directly inshore is indeed the salvage camp, not just materials washed in from the 41KN10 wreck. Establishing the site of the salvage camp confirms the northern most wreck site as that of the *San Esteban*, the one hulk visible above the water when the salvage expedition arrived. The identity of the middle and southern wrecks then fall into place as the *Espiritu Santo* (41WY3) and *Santa Marja de Yciar* (41WY23) respectively. What an important thing just one more piece of evidence can be

Acknowledgements

Support for this project was supplied by several National Park Service managers and archaeologists, especially Richard Sellars, Ron Ice, and Dan Lenihan. Ken Vrana was boat captain and mechanic aboard the *Anomaly*, which sported a propwash deflector newly designed by Larry Murphy, who helped in the field. Captain Ken Fort and the *Natural High* relocated anomalies as they were shot in by Kary Kaley of the Tennessee Valley Authority or Art Ireland of the National Park Service. Other essential crew members were National Park Service employees Toni Carrell, diver and mag operator, and divers Kent Keller and Jenny Bjork. Administrative help was supplied by Superintendent Bill Lukens, Malcolm Pace, and other Padre Island National Seashore staff, as well as by Toni Curran, who typed the manuscript. Illustrations were prepared by Ernesto Martinez. To all these people go our thanks.

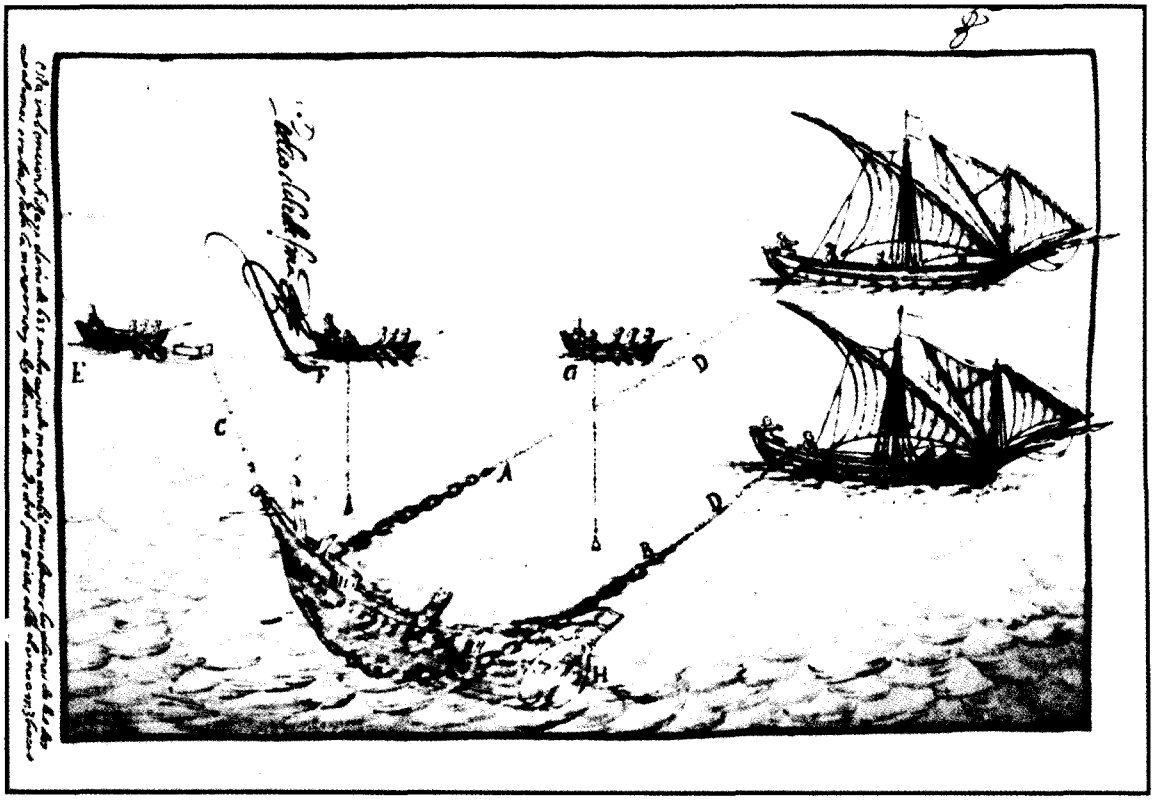


FIGURE 3. A rendering of the salvage technique used by Pedro de Ledsma in 1623 (after McDonald and Arnold 1979: Figure 28).

REFERENCES

ARNOLD, J. BARTO III
1976 An Underwater Archaeological magnetometer survey and site test excavation project off Padre Island, Texas. *Texas Antiquities Committee Publication No. 3*. Austin, Texas.

ARNOLD, J. BARTO III and ROBERT S. WEDDLE
1978 *The Nautical Archaeology of Padre Island: The Spanish Shipwrecks of 1554*. Academic Press, New York.

BREINER, SHELDON
1973 *Applications Manual for Portable Magnetometers*. Geometrics, Palo Alto, California.

McDONALD, DAVID and J. BARTO ARNOLD III
1979 *Documentary Sources for the Wreck of the New Spain Fleet of 1554*. Austin, Texas.

NORDBY, LARRY V. and J. BARTO ARNOLD III
1985 Preliminary Report on the Padre Island Archaeological Research Project of 1985. Paper presented to the Seventeenth Conference on Underwater Archaeology. Sacramento, California.

NORDBY, LARRY V. and LARRY E. MURPHY
1984 Archaeological Survey at Padre Island National Seashore, Texas: A Request for Proposals. National Park Service, Southwest Cultural Resources Center, Santa Fe.

PALACIO, DIEGO GARCIA de
1986 *Nautical Instrction, 1587* (Translated by J. Bankston, 1986). The Press, Bisbee, Arizona.

PORTILLO, J.
1975 *Nautical Terms in Sixteenth Century American Spanish*. University Microfilms International, Ann Arbor, Michigan.

WEDDLE, Robert S.
1985 *Spanish Sea: The Gulf of Mexico in North American Discovery, 1500-1685*. Texas A & M University Press, College Station, Texas.

J. BARTO ARNOLD, III
UNDERWATER RESEARCH SECTION
TEXAS ANTIQUITIES COMMITTEE
AUSTIN, TEXAS 78711

LARRY V. NORDBY
BRANCH OF CULTURAL RESEARCH
SOUTHWEST CULTURAL RESOURCES CENTER
NATIONAL PARK SERVICE
SANTA FE, NEW MEXICO 87501

STEPHEN R. JAMES, JR.

The Barks *La Grange* and *Ninus*: Two Recent Additions to the Growing Number of Gold Rush Era Shipwreck Sites

Introduction

In February and June of 1986, a cultural resources investigation was conducted in the Sacramento River opposite the Old Sacramento National Register Historic District. The investigated project area is adjacent to one of the most significant sites in California's early history. In the mid-1840's, John Sutter established his outpost, Sutter's Fort, approximately three miles east of the river. Sutter's Embarcadero located at the mouth of Sutter Slough provided a permanent landing for vessels bringing supplies to the outpost (Hunter et al. 1984). The discovery of gold funneled a migration of thousands of fortune seekers through the Embarcadero. What was once a small landing for a remote outpost transformed almost overnight into a burgeoning town. A lithograph entitled "Ville de Sacramento" shows the area less than one year after the discovery of gold.

Sailing ships provided the initial means of transportation to Sutter's landing and what was to become the City of Sacramento. Depending on the winds, the vessels were towed by long boats rowing ahead, sailed or even kedged towards their goal. Initially, numerous large square-rigged sailing vessels made their way to the Embarcadero. Some vessels were large, and one, the *Whitton*, a 500-ton barque (bark), was approximately 120 ft in length (Zelinsky and Olmsted 1985). Numerous ships lost their crews to the lure of quick riches and many vessels, no longer employed as sailing ships, were utilized as hotels, warehouses, stores and jails. By May 1850, 33 storeships lined the banks of the Embarcadero (McGowan 1976). Some of the hulks, as they were known, remained at the waterfront up to and possibly after 1879 (Zelinsky and Olmsted 1985).

Riverfront Investigations

In 1986 cultural resources investigation of two separate areas of the river bed and bank were implemented for the Sacramento Housing and Redevelopment Agency by nautical archaeologists employed by Espey, Huston & Associates, Inc. (EH&A). Area I, approximately 550 ft in length, is located between the I Street Bridge and the northern extent of the newly reconstructed Old Sacramento Riverfront Wharf (Figure 1). This area was investigated in February. Area II, which was investigated in June, is approximately 4,100 ft in length. It is located between M Street or Tower Bridge and Highway 80 or the Pioneer Bridge. The investigation of both areas was comprised of a side scan sonar survey and subsequent diver assessment of significant side scan targets to determine their physical and historic nature and to assess their potential eligibility to the National Register of Historic Places (NRHP).

Area I

A total of six targets were mapped from the 100 kHz data in the area just south of the I Street Bridge. All six side scan sonar targets were located and identified by divers. Of the six targets, Targets 4 and 5 proved to be the historically significant remains of a copper-sheathed sailing vessel. The wreckage areas, thought to represent the remains of a single vessel, were delineated and received preliminary archaeological investigations. The remaining four targets were composed of non-significant natural and man-made debris.

Target 4 is composed of at least four disarticulated planks, two of which are known to be outer hull planking because of the presence of attached copper sheathing. Due to the presence of copper sheathing, the wreckage appears to represent the remains from an ocean-going vessel and most likely those of a sailing ship. In all probability, the wreckage is a downstream deposition of components from the wreckage identified at Target 5, which lies approximately 100 ft upriver from Target 4.

Reconnaissance by archaeologists revealed Target 5 to be comprised of a large area of both articulated and disarticulated components of an ocean-going sailing vessel. Preliminary investigation of the wreck site showed a 20 ft (6.1 m) section of the ship's keel located approximately at the base of the riprap (Figure 2). The keel is situated parallel to the floodwall and is held in place by the riprap. At least four unevenly spaced flat floors are attached to the top of the keel by a single brass clinch bolt. Adjacent to and just upslope of the keel is a line of articulated futtocks protruding from the riprap. On the opposite (west) side of the keel is a large area of disarticulated frames, planking and assorted wooden hull members. Some of these are partially buried in the river bed, while others lie loose. The keel is copper sheathed as is the garboard strake and adjacent outer hull planking. Observed between the exterior planking and copper sheathing was a layer of pine pitch-covered canvas-like cloth.

The overall impression of the wreck is that it has been severely disturbed. In 1972, a copper-sheathed sailing vessel was indeed impacted during the laying of telephone cable across the Sacramento River adjacent to I Street (Sacramento Bee 1984:1; Museum Page 1973). While excavating the cable trench, the dredge tore through the ship. A windlass, rudder gudgeons, sections of a hatch combing and numerous frames, strakes and assorted timbers of the vessel were raised along with dredge spoil. Noteworthy pieces, as well as an assortment of frames and planking, were retrieved by personnel from the Sacramento Museum and History Division. However, the majority of the raised pieces were relegated to the dredge spoil pile and eventual destruction (Helmich 1986).

Wreck Identification

While the submerged and salvaged wreckage was easily recognized as the remains of an ocean-going sailing vessel, the problem of wreck identity becomes apparent when one realizes that between 1850 and 1875, depending on the demand created by the Gold Rush, the Comstock Lode or construction of the Central Pacific Railroad, as few as 300 or as many as 900 sailing ships arrived at Sacramento in one year. It is plausible that the wreckage represents the remains of one of the vessels known to have been moored or anchored and subsequently sunk along the Embarcadero in the present area under investigation. The project area includes the waterfront from what was the mouth of Sutter's Slough, the present location of the I Street Bridge (H Street), to the north side of J Street. Preliminary research has thus far uncovered evidence of two wrecks known to be present in the wreck site area. The two wrecks are noted in an article in the Sacramento Daily Union (June 30, 1864, 3-1).

> "Last evening, a survey of the river at point where barge Pike ran aground just above Sacramento. Here also is the wreck of the old prison brig, and wreck of Cooper's hulk, both partially sunk but visible. Another barge partially

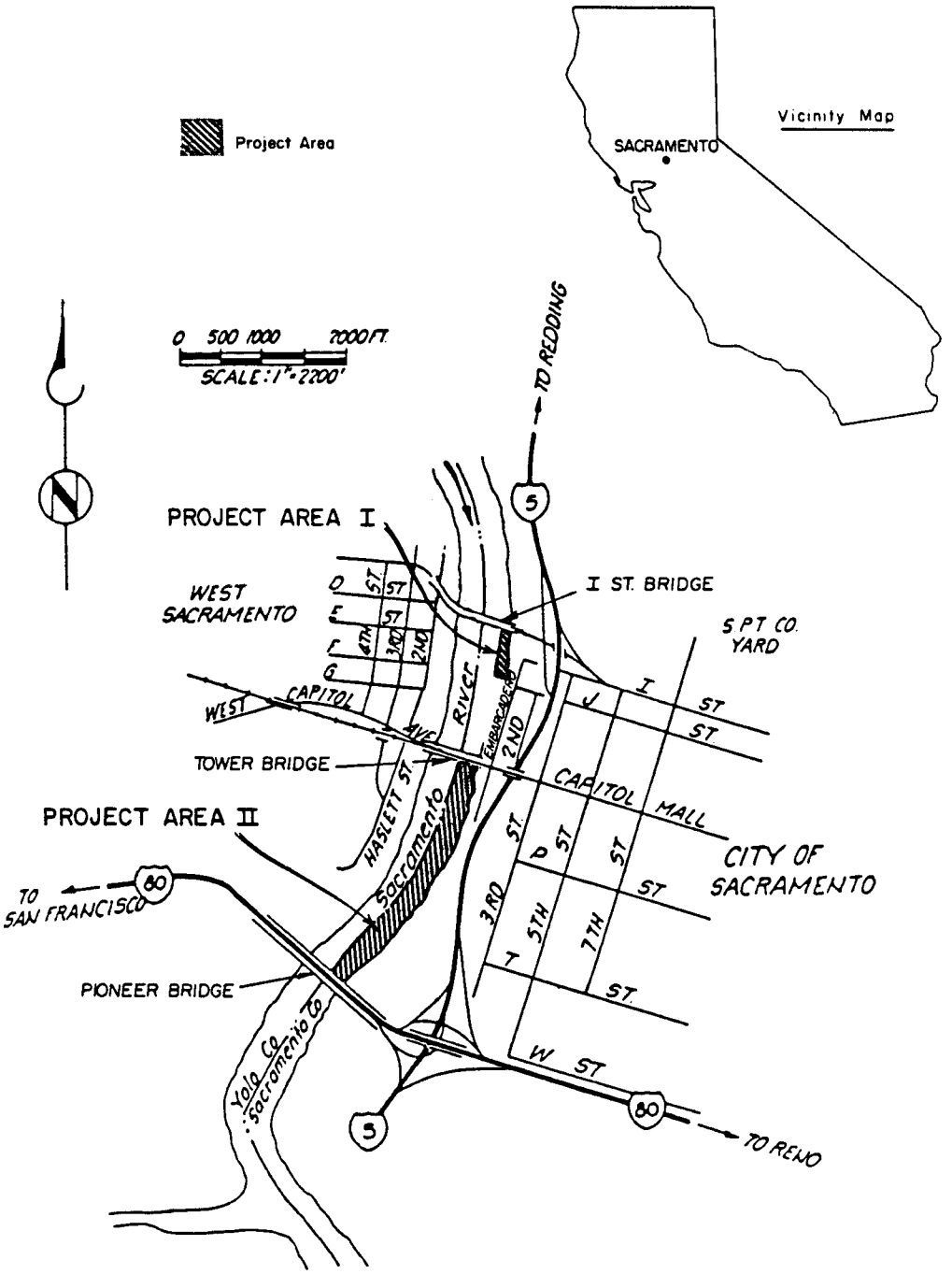


FIGURE 1. Project location map

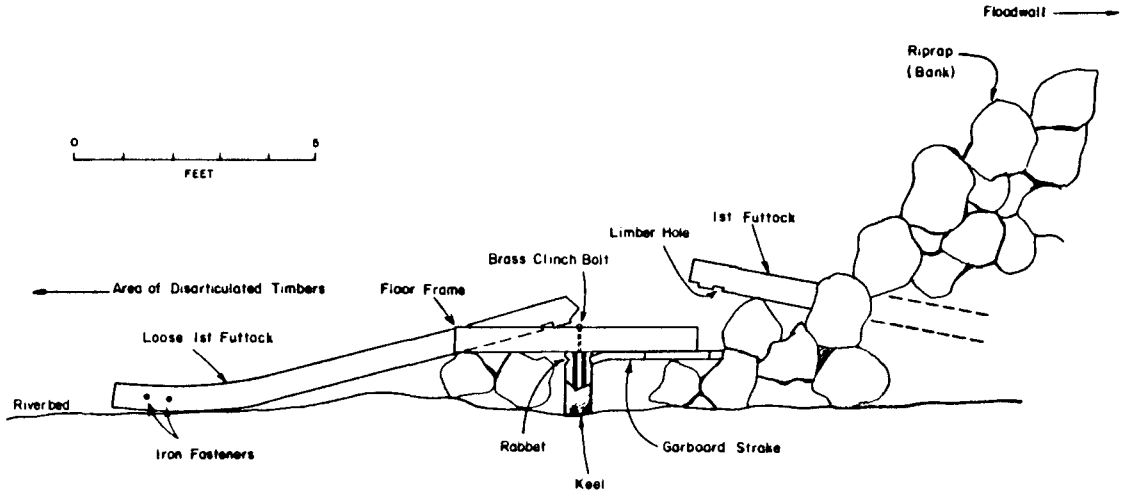


FIGURE 2. Side view at southern end of main wreckage area, Target 5

aground on bar. All these craft aid in forcing water to Yolo side, forming sand bars on Sacramento side. The removal of the old prison brig should claim attention of the City Trustees."

The prison brig and Cooper's hulk are the wrecks in question. The identity of Cooper's hulk is unknown but it may be the hulk *Mazeppa* whose stern, like that of the prison brig, was leaning on the sandbar when the river subsided (Sacramento Daily Union, November 18, 1859). Although the identity of Cooper's hulk is unknown, it is well documented that the prison brig was originally *La Grange*, a bark built in Portsmouth, New Hampshire.

The current wreck under investigation, the "cable-crossing wreck" as it has been called, is locally believed to be that of *La Grange*. The belief is based apparently on the fact that the prison brig *La Grange* was anchored or moored in this area and eventually sank at her moorings. *La Grange* was built in 1835 by the Samuel Badger, a master carpenter. Her tonnage, as listed on her registration documents, is 259 47/95 with a length of 95 and 3.5 tenths feet, a beam of 25 and 5 tenths feet and a depth of hold of 12 and 2.5 tenths feet. She was a three-masted square stern barque with a single deck and a billet head (National Archives 1835). *La Grange* was involved for a good part of her career in the Southern packet trade (Delgado 1986a) and some 13 years after being built she was purchased by the Salem and California Mining and Trading Company. She was outfitted and sailed for the gold fields from the port of Salem on March 18, 1849 and arrived in Sacramento on October 3, 1849.

The 65 men of *La Grange's* compliment formally disbanded in late November and their community goods, equipment and the vessel itself were sold at auction (Richardson 1979:109). They "sold the copper off the vessel for sieves to make gold rockers, the sails for roofs of houses, the running rigging for lashings on wagons, the galley for a lawyer's office, and then sold the hull to the City of Sacramento for a prison brig..." (Saunders 1974:5). City records indicate that *La Grange* was not purchased until June 1850 and then at the "ridiculously low" price of $2,400.00 (Peterson n.d.). She was purchased as a replacement for the 310 ton bark *Stafford* which was employed as the county's first prison ship. The prison ship or prison brig as *La Grange* was to be known, was ordered moored in the mouth of the American River, above the bar opposite H Street. $2,500.00 was expended in repairing her and $75.00 was provided for a cooking stove. The ship was stripped to its masts, the hold partitioned off into cells and additional structures built on deck (Saudems 1969:68). Additional excerpts from city records indicate that:

> "The forward oak cabin was used as a dungeon, while the available space in the enclosed deck was utilized as a "dining room" and kitchen. Cells were built in the hull, with heavy iron rings fastened securely into the wall. To these unruly prisoners were chained until the bread and water diet cooled them down. Heat in winter was provided by a large, round-bellied cast iron stove capable of taking large chunks of wood. Such lights as were allowed were furnished by candles and "lard-oil lamps"." (Peterson n.d.)

Two lithographs exist which depict the prison ship. The first, the original or which is located at Sutter's Fort, shows a huge stylized superstructure with numerous windows, multi-stories with split levels, all of which extends beyond the rail line over the water. It is

believed that this illustration is a grossly exaggerated and romanticized artists' interpretation. The second, an 1857 lithograph , shows the vessel moored opposite what would now be H Street with "...an eight-foot wall of heavy boards erected on its deck, along the line of the rail, the whole being decked over with a hip roof. There appears in the stern a slightly higher section of this enclosure, the headquarters of the jailers and guards" (Peterson n.d.). An enlargement of the prison ship illustrated corresponds to the historical account of the prison vessel's superstructure .

The prison ship served as the city and county jail for approximately 10 years. Exceptionally heavy rains signaled the end of the prison ship. In November 1859, the area saw a week of rain with the river finally overflowing its banks at Sacramento. The river rose so rapidly that the guards on board the ship did not have time to loosen its bow and stern moorings. The vessel, because of its moorings, could not rise with the river and it began to fill with water. The prisoners were safely removed and the ship continued to fill until it finally sank. When the water subsided, it was found that sands and sediments filled the hull, almost covering the ship itself (Peterson n.d.). As high waters receded, it was observed that the ship was held securely in place by a sandbar. She was sold at auction for $205.00 to T.A. Talbot and Leonard Harris who in turn sold her to a group of Chinese. They removed most of the usable portions and left the remaining hulk half suberged (Saunders 1969:77-78).

The wreck evidently caused, to some degree, the formation of a sandbar in front of the city which resulted in navigation problems. Numerous attempts at removing the wreck met with little success. Newspaper accounts of these unsuccessful attempts ceased in the mid 1860's and the wreck was forgotten until 1972 when dredging operations impacted the vessel at Target 5. While as yet unidentified upcoming archaeological and archival research work planned for the wreck may shed light on its identity.

Area II

In June an archaeological reconnaissance was conducted in the survey area south of M Street. During the nineteenth century, the northern waterfront between I and M streets was the focus of shipping activities and was of primary economic importance when contrasted to the southern waterfront which stretched south from M Street. The Sacramento Daily Union in 1851 lists numerous storeships and steamboats moored opposite dozens of businesses located on Front Street between I and M streets. The article states that only a very few shops were beginning to appear south of M Street along the levee (McGowan 1976:46-47). The 1860s saw the southern waterfront as a place to moor sailing vessels which had outlived their usefulness along Embarcadero. The vessels were often broken up for their iron, copper and wood, or as sometimes happened, were forgotten until they sank, at which point they became prominent once again in the shipping community, this time, however, as navigation hazards.

The waterfront between M and R streets developed eventually into a specialized commercial strip with the City's lumber trade being located here. The R Street landing was a main shipping point for the lumber trade. An 1870 lithograph drawn by A. Koch depicts the R Street landing situated from Q Street to just below R Street . The landing is covered with what appear to be stacks of lumber. Between 1871 and 1873, ten thousand cords of wood, two to four million feet of lumber and fifteen to twenty thousand tons of cobbles left the R Street landing for San Francisco. This bulky type of freight was transported mainly by schooners and sloops, although barges played an active role (McGowan 1976:21-22). The 1870 lithograph also depicts a deserted waterfront between Q and N streets where a steamboat landing is present.

Of the 16 targets identified in this area as potentially signigicant, three were recognized during diver reconnaissance as the remains of historic sailing or river vessels. Target 9 represents the location of a river vessel rudder, Target 7 represents fragments of two hull planks of a copper-sheathed vessel and Target 5 represents the articulated and well preserved lower hull of an ocean going sailing vessel.

The Target 9 rudder is composed of three planks connected by iron drift bolts. A large iron strap is bolted to the larger of the three planks (Figure 3). A pintle-like projection is located at the top of the iron strap and an iron connecting rod is fastening to the projection. The projection goes through an eye in the end of the connecting rod and the rod is locked into place by a small iron key. Early photographs of barges show similar rudders and the connecting rod connected several rudders to one another thus making all rudders turn as one. Because only one connecting rod was present, it is thought that the rudder would have been an outside rudder, probably a main rudder. The internal or slave rudders would have had two connecting rods. While the rudder, in all probability, was associated with a barge, the time period of the barge is in question. Photographs of the late 1870's depict barges with this type of rudder (Zelinsky and Olmsted 1985); however, barges were employed extensively in Sacramento since at least 1851 (McGowan 1976:22). Little is known of these early barges and it is uncertain whether they employed similar rudders. The barge type that was present on the river from at least the late 1870's to the 1930's were "big flat scows with quadruple rudders, and were steered from a pilothouse built up on stilts like a country windmill tower so that the helmsman could see over the high deckload of potatoes, grain, onions, chicory or whatever else they were hauling" (MacMullen 1970:84). Strings of these barges were towed by a single sternwheeler and the steering mechanisms enabled the barges to navigate sharp bends in the river.

Two small sections of hull planking were observed at Target 7. The strakes are composed of a 2.3 inch thick main plank. Fastened to the outside surface of this main strake is a thin secondary strake which is 3/4 of an inch thick. A thick layer of pitch-soaked hay or straw is present between the thin outer strake and main strake. This "poor man's" coating (Delgado 1986b) is in contrast to the pitch-soaked canvas found on *La Grange* (James 1986a:31) and the pitch-soaked felt or animal hair found on the wreck at Target 5 (below). It is interesting to note that both Strake 1 of Target 7 and the wreck at Target 5 have a coating of pitch between the main and a thin outer strake, while *La Grange* does not have thin outer strakes, but has a coating of pitch and canvas applied to the main strake and this in turn sealed by copper sheathing. Although sheathing was not present on the strake, evidence in the form of numerous sheathing nails and nail impressions indicated its former presence.

Target 5 proved to be the well-preserved lower hull of an ocean-going vessel. The wreck was assessed and mapped over the course of two days. Mapping focused on key elements of the wreck in order to obtain a general overview of the wreckage and identification and location of its major components. While numerous construction details and artifact types and locations were recorded, an assessment period of two days mandated that many areas of the wreck would go unmapped.

The remaining length of the articulated hull remains is approximately 74 ft (22.6 m). The postulated original length of this level of the hull, obtained by projecting the eastern (starboard?) run of the hull to the projected line of the keel, is approximately 80 ft (24.4 m). While the projected length is 80 ft (24.4 m), it is believed that the stern area, containing what appears to be deadwood, would have projected

further south, terminating at the sternpost. Similarly, it is believed that the bow also would have projected somewhat further its termination point being the sternpost. With the vessel's original length being measured from the inside of both the stem and sternpost and due to the apparent absence of the stem and sternposts (although the base of the sternpost may be buried), the vessel length at this time is unknown. However, with the present data, it is assumed that the vessel would approach 90 ft (27.5 m) in length.

The turn of the bilge is easily recognized along the eastern run of the hull, approximately amidships. The greatest distance between the center line of the keelson and the turn of the bilge is approximately 14 ft (4.3 m). This in turn equates to a breadth of 28 ft (8.6 m). However, it appears that the eastern edge of the hull is splayed resulting in an incorrect breadth measurement. It is postulated that the actual breadth is several feet short of 28 ft (8.6 m). The hull east of the keelson and line of the keel is more exposed and seemingly more intact than the western half of the wreck. The run of the hull is easily located and followed by exposed futtock ends and sections of copper-sheathed hull strakes. The futtocks and hull strakes are preserved in the midship area of the wreck to approximately halfway up the turn or the bilge. The hull west of the line of the keel appears to be slightly less intact than its eastern counterpart. The run of the hull with hull planks and copper sheathing is not visible, as it is on the eastern half. In many cases, the frames project into or are covered by sand. However, there is evidence of major post-wreck disturbance or impacts on this area, probably as a result of dredging operations. A 4 ft to 5 ft (1.2-1.5 m) diameter hole has been ripped through frames, planking and sheathing. Numerous pieces of buckled copper sheathing were noted. The buckled sheathing is thought to be characteristic of the damage caused by the dredging. The beginning date of intensive dredging adjacent Sacramento is unknown. However, by the late 1920s and early 1930s, dredging was taking place in the project area. The dredging must have impacted and possibly even destroyed submerged cultural resources within the project area. The impacts to the wreck at Target 5 lend credence to this statement.

With the exception of dredging activities and an occasional snagged anchor, the vessel remains, from the time of possible Gold Rush era salvage and original deposition, appear to have gone undisturbed by human agency. Prior to the investigation by EH&A archaeologists, the Target 5 wreck was unknown to the diving community (Taylor 1986). The presence of artifacts attest to this statement. Included in the artifact assemblage are a single chainplate with in situ dead eyes, several iron sheaves, an iron belaying pin, a figurehead pipe, a Scottish Kaolin pipe, an anchor's stock key, a lead patch, a whiteware mug, a lock and numerous iron and copper alloy fasteners.

Wreck Identification

Preliminary research has uncovered evidence for two wrecks, *Dimon* and *Ninus*, known to be present in the area which contains the Target 5 wreckage (James 1986b). Both vessels were of similar size, *Ninus* having a length of 92 ft, *Dimon* 85 ft, *Ninus* having a breadth of 25 ft and *Dimon* 24.5 ft. The postulated size of the wreck, with a length of over 80 ft and up to 90+ ft, and a breadth of near 24, 25, or 26 ft, corresponds easily with the dimensions of both *Ninus* and *Dimon*. Therefore, a distinction as to the wreck being the remains of *Ninus* or *Dimon* cannot be made at this time by comparing and contrasting vessel dimension.

The actual historic location of *Ninus* and *Dimon* at the time of sinking and the events afterward may help shed light on the wreck's identity. *Dimon*, "which has been lying at the foot of R Street," sank in 1868. *Ninus* "in the River below R Street" sank in 1861. The actual position of the Target 5 wreck is opposite S Street and approximately

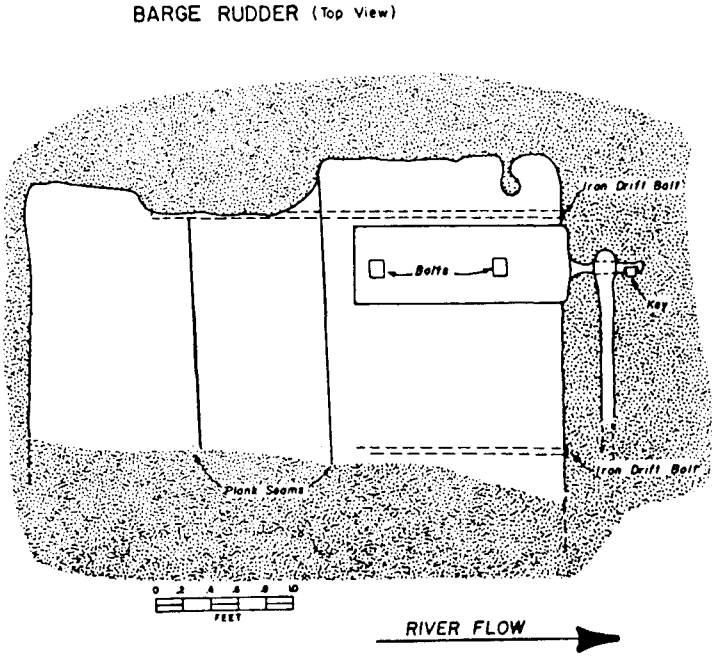


FIGURE 4 . Target 9, Barge rudder

100 ft (30.5 m) from the bank. The location of *Ninus*, in comparison to *Dimon's*, corresponds more closely to the actual wreck location. *Ninus* is nearer S Street and she is "in the river" as opposed to "at the foot of R Street" which seemingly implies that *Dimon* was tied up to the bank. While the fates of the *Ninus* and *Dimon* are unknown, the newspaper articles state that *Ninus* is a wreck and her upper works had been removed, not for salvage purposes but to counteract shoaling. *Dimon*, on the other hand, is not mentioned as a wreck but as a hulk that sank and indications are that she was to be removed and broken up. Possible evidence for *Dimon's* removal is noted in A. Koch's lithograph of 1870. The R Street Landing, an important shipment point for lumber, was present by 1870 at the foot of R Street. While unsubstantiated, the removal of the *Dimon* would appear necessary for the building of or navigation to the landing. The construction date for the landing is unknown.

Conclusions

While we can approximate the time frame in which both vessels arrived and were present at Sacramento, the preliminary nature of the investigation allows only speculation concerning their roles in the city's birth and growth. Although as yet unsubstantiated, both are in all probability associated with the Gold Rush, an event which shaped the development of the Pacific Coast as well as the economic history of the United States. Depending on identities, they may have been employed as storeships, a distinctive characteristic of the Gold Rush waterfront. Also dependent on identity is the significance of their roles in the coastal and ocean packet trades, and possibly the whaling industry. Regardless of the vessels' identities, their function in maritime commerce or Sacramento's history, the wrecks represent excellent and significant examples of nineteenth century American wooden ship construction. Their remains offer a unique opportunity to observe and record construction techniques and materials of that period, a period which maritime archaeological research has for the most part ignored.

REFERENCES

DELGADO, JAMES P.
1986a Personal communication. Letter on file.

1986b Personal communication. Letter on file.

HELMICK, STEPHEN G.
1986 Personal communication.

HUNTER, JACK, STEPHEN P. HELMICH, AND MONICA REED
1984 *Old Sacramento Waterfront Underwater Archaeological Survey*. Prepared for the Sacramento Housing and Rede velopment Agency, Sacramento, California.

JAMES, STEPHEN, R. JR.
1986a *Submerged Cultural Resources Survey, Sacramento Embarcadero, Sacramento, California*. Prepared for the Sacramento Housing and Redevelopment Agency, Sac ramento, California. Espey, Huston & Associates, Inc. Doc. No. 860486, Austin, Texas.

1986b *Underwater Archaeological Investigations, "Docks Area," Sacramento, California*. Prepared for the Sacramento Housing and Redevelopment Agency Sacramento, California, Espey,Huston & Associates, Inc. Doc. No. 860964, Austin, Texas.

MACMULLEN, JERRY
1970 *Paddle-Wheel Days in California*. Stanford University Press, Stanford, California.

MCGOWAN, JOSEPH A.
1976 *The Sacramento Waterfront 1848-1875*. Prepared for the Sacramento Housing and Redevelopment Agency and the City of Sacramento History Center.

MUSEUM PAGE
1973 November, No. 4. Sacramento, California.

PETERSON, HARRY C.
n.d. The End of the *La Grange*, Unpublished manuscript, filed in "Citizen's Letters," California Room, California State Library, Sacramento, California.

RICHARDSON, KATHERINE WOOD
1979 The Gold Seekers: The Story of the *La Grange* and the California Pioneers of New England, *Essex Institute Historical Collections*, Vol. 115, No. 2.

SACRAMENTO BEE
1984 Hull in River Forces Redesigning or Wharf. August 14 edition, page 1.

SACRAMENTO DAILY NEWS
1859 November 18 edition, page 3, column 1. As presented in *The Sacramento Waterfront 1848-1875*, Joseph McGowan, 1976.

1864 June 30 issue. As presented in *The Sacramento Waterfront 1848-1875*, Joseph McGowan, 1976.

SAUNDERS, DOLORES VIRGINIA
1969 The Sheriff's Department of Sacramento County, 1850-1879. Unpublished Masters Thesis, Sacramento State College, Sacramento, California.

1974 Sacramento's Prison Ship 1850-1859. *Golden Notes*, Vol. 20, No. 3.

TAYLOR, BOB
1986 Personal communication.

ZELINSKY, EDWARD GALLAND AND NANCY OLMSTED
1985 Upriverboats - When Red Bluff Was the Head of Naviga tion. Reprinted from *California History* Spring 1985.

STEPHEN R. JAMES, JR.
ARCHAEOLOGY DEPARTMENT
ESPEY, HUSTON & ASSOCIATES, INC.
PO BOX 519
AUSTIN, TEXAS 78767

DAVID COOPER

1986 Survey of the Schooner *Fleetwing*, Garrett Bay, Wisconsin: A Preliminary Report

Introduction

The *Fleetwing* site is well known to local residents and divers, and serves as a popular site for fishing and sport diving. However, continuous looting in recent years has resulted in the loss of most of the schooner's moveable artifacts, including the windlass and unsalvaged potions of her cargo (Ellis 1969:357-359). The site's exposed location subjects its shallower portions to continued wave action, as well as damage by ice shoves. The fact that the site is well known and is subject to a slow but continual process of human and natural attrition identified it as an important location for a cultural resource assessment.

The *Fleetwing* survey had two intents; to document the extant wreckage, and to generate basic data on the construction techniques employed by her builders. Lake vessels of this period were often constructed on traditional lines without the benefit of naval architectural plans, and much of this data is accessible only through architectural plans, and much of this data is accessible only through archaeological investigation. As the first such study in the area, the data generated was hoped to lay the foundation for future work.

The survey was funded through East Carolina University's Program in Maritime History and Underwater Research. In addition to a grant for operational expenses, the University provided the project with a truck, boat, surveying and diving equipment, and the services of staff archaeologist Brad Rodgers. Volunteer assistance was provided by Barry Rodgers of the University of Wisconsin-Madison. David Cooper, a graduate student at East Carolina University, acted as principal investigator and project director.

Site Location

Garrett Bay is located in Hedgehog Harbor, at the northern end of Wisconsin's Door County peninsula (Figure 1). Hedgehog Harbor's western boundary is marked by Death's Door Bluff, and the eastern boundary by Table Bluff, the last headland before Death's Door Passage. The two mile distance between the headlands constitutes the mouth of Hedgehog Harbor. Garrett Bay is the western half of this harbor, separated from the eastern half by a small unnamed promontory. Hedgehog Harbor faces due north into the waters of Green Bay, completely exposed to northern winds.

Site History

Garrett Bay contains at least two sites of archaeological interest, one terrestrial, the other submerged. The terrestrial site consists of several building foundations and trash middens from a nineteenth century logging settlement. The submerged site (the focus of this investigation) consists of wreckage from the lumber schooner *Fleetwing*, run ashore in a gale in 1888, contemporary with the lumber settlement. Also in the area of the wreck, though not included in the survey, are at least three cobb-style wharf cribs, presumably from the pier of Andrew Nelson, reported to have existed in the vicinity at the time of the wreck (Frederickson and Frederickson 1963:70; Door County Advocate 1888).

The *Fleetwing* was built in Manitowoc, Wisconsin in 1867 at the yard of the German shipwright Henry Berger. Constructed especially for the buffalo grain trade, she was also intended to carry cargoes of lumber, and was provided with loading ports in her sides. She was built in six months by a crew of twenty-three men, at a cost of $30,000. Her cargo capacity was for 18,000 bushels of grain or 225,000 board feet of lumber. She measured 349.78 total tons, and her dimensions were; 136' length, 28.5' beam, and 11' depth of hold (Enrollment 90, Port of Chicago, 1872; Manitowoc Pilot 1867).

Her schooner rig was characteristic of many Great Lakes cargo vessels of the nineteenth century. The east to west trade routes along the lakes forced masters to spend much time beating against the prevailing winds. The schooner's improved windwardliness and handling in restricted waters made these vessels popular for Great Lakes navigation. Their low operating costs and small crews made them doubly attractive to the small, often family owned, shipping concerns. Additionally, a schooner's booms and rigging were easily removed, making its hold more accessible to bulk cargo unloading equipment than a square-rigged vessel with its many spars and miles of rigging. Topsails were frequently added to increase running speed, and centerboards were in common use even on large vessels to further improve handling to windward (Chapelle 1982:219-272; Cuthbertson 1931:228-241; Hirthe and Hirthe 1986:vii-viii).

The *Fleetwing's* twenty-one year career was ended on the night of September 26, 1888. Sailing from Menominee, Michigan to Chicago with a load of lumber, she attempted to negotiate Death's Door Passage despite darkness and high winds (Door County Advocate 1888). A canal at Sturgeon Bay had been cut to allow vessels to pass from Green Bay into Lake Michigan, thereby avoiding the dangerous journey through the shoals and islands of the infamous Death's Door. However, schooner masters were understanding orders from owners to risk the uncertainties of Death's Door rather than the certainties of a fat towing bill from a Sturgeon Bay canal tug, unless weather permitted use of the cut unassisted, or prohibited passage through the Door (Door County Advocate 1886).

In the darkness the *Fleetwing's* master, Edward Finn, mistook Death's Door Bluff for Table Bluff and dropped off to the east, intent on passing through the Door into the open lake. The error was not realized until too late, and the heavily laden vessel sailed straight into Garrett Bay, fetching up hard on the rocky bottom alongside Andrew Nelson's pier. The collision sheared off a mast, and the vessel filled with water until her stern settled to the bottom. The crew took refuge at Nelson's home, apparently uninjured (Enrollment 144, Port of Chicago, 1881; Frederickson and Frederickson 1963:70).

It took several days to locate assistance, but eventually the wrecking tug *Spalding* arrived from Sturgeon Bay to free the stranded vessel. Not long after her crew had installed a pump aboard the *Fleetwing*, the Spalding was forced to flee before a northeast storm. Returning, she found that the stranded schooner had gone to pices in the storm, and was beyond repair. The cargo was salvaged, the equipment was sold to the schooner *Conquest*, and the *Fleetwing* was abandoned (Door County Advocate 1888; Frederickson and Frederickson 1963:70).

Field Investigation

The 1986 survey team commenced on-site operations on August 4, 1986. Ten work days were allocated to the project (8/4/86 to 8/15/86) though two days were lost to bad weather. August was chosen as the best time of year for favorable weather. Environmental conditions on site were mild, with zero to three foot waves, ten to

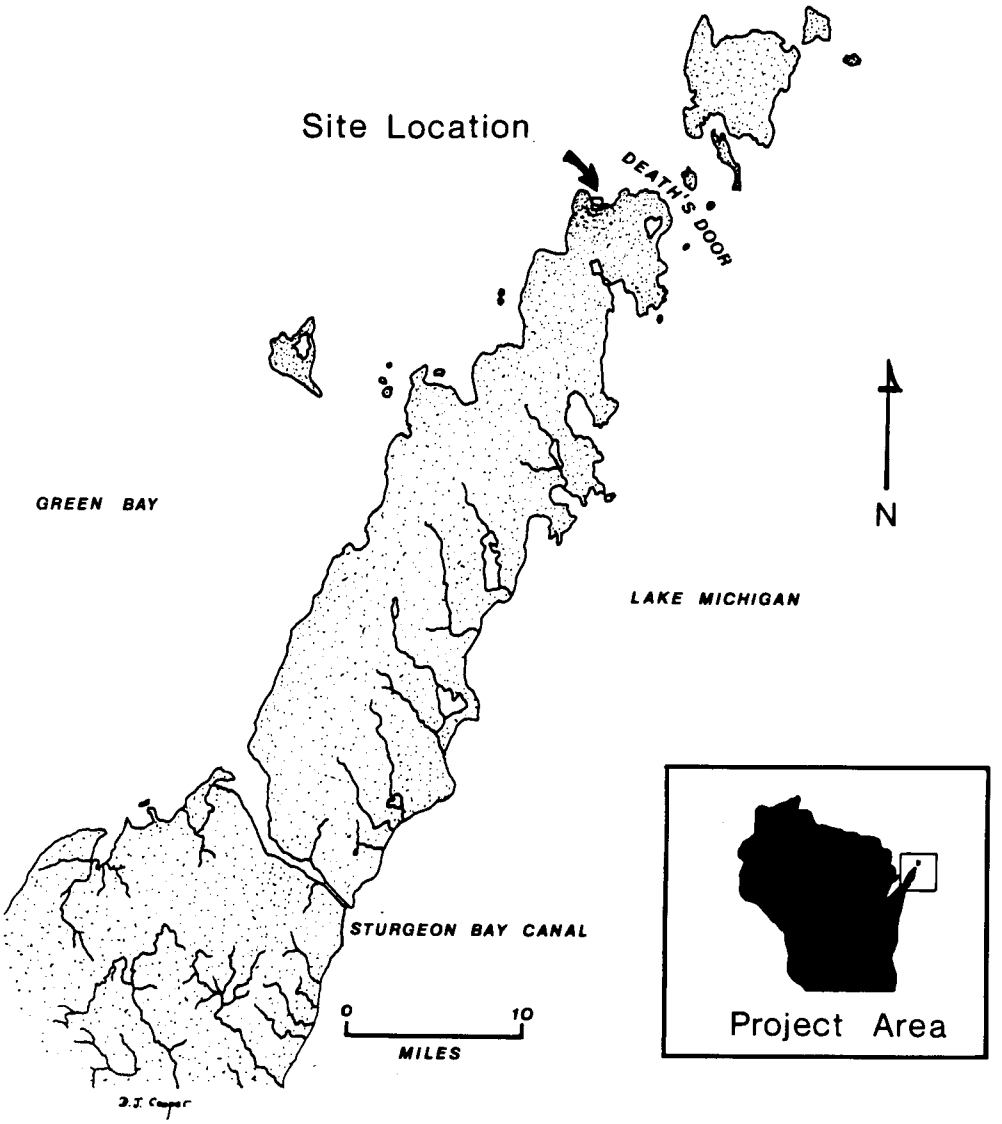

Site Location
DEATH'S DOOR
GREEN BAY
LAKE MICHIGAN
N
STURGEON BAY CANAL
0
10
MILES
Project Area

FIGURE 1.

twenty feet of visibility, and a surface water temperature of 58 degrees Fahrenheit.

Surveying the site was a fairly straightforward endeavor. An initial diver reconnaissance was employed to locate the major sections of wreckage. These sections were designated by letter in the order of their discovery. The inshore and offshore axis of each piece were buoyed and given a code number, "1" for inshore axis, "2" for offshore axis. Therefore, the inshore end of wreckage section D was buoyed as "D1", and so forth.

A datum point was established on the Garrett Bay public boat landing, which was surveyed to a nearby county survey marker. These two points formed the zero degree baseline for the transit station located at the landing datum. Azimuth readings from the transit were recorded for each buoy. With the use of a small boat, a reflector mirror was positioned at each buoy location and an electronic distance measurer (EDM) recorded the distance from datum. Plotting of these distances and the azimuth readings produced an accurate site map of the orientation and location of the major sections of wreckage. The buoying and surveying were done on a calm day, and the lack of tides on the Great Lakes insured that the buoys could be fastened in a vertical position over the wreckage in question. This accuracy was verified with corroborating underwater measurements.

The site was found to consist of structural portions of the hull scattered over approximately 540 feet in a northwesterly direction, probably due to the combined actions of storms and ice packs on the wreck (Figure 2). The quantity or wreckage and initial reconnaissance led to the hypothesis that material from another vessel was obtrusive to the site. Limitations of visibility disallowed single pieces to be viewed in their entirety from a single vantage point, and extensive mapping was necessary to form a better understanding of the site.

Mapping and Identification

Of the six pieces of wreckage only section D was immediately identifiable. This section is the vessel's heavy keelson assembly, consisting of the keel, keelsons, floors, centerboard trunk, and mast steps. D is closest inshore of all the wreckage, and the largest section of the extant hull structure. Here, ninety-nine feet from the present shoreline, the schooner's backbone lies on what was probably her last bearing.

Section D is located on a sloping rocky bottom, with eleven feet of water at the bow and thirteen at the stern. A study of the members revealed the *Fleetwing* to be entirely of wood, with iron fastenings. She was double framed, with frames placed in pairs of a 4" wide frame forward and a 5" wide frame aft (Figure 3). This framing pattern was found to continue throughout the hull. Floors were approximately 9" deep, and frame sets were spaced 10" to 1' apart, with 1" deadspace in a set. The floors and futtocks were butt-scarphed, and paired frames were fastened to each other horizontally with 1" diameter iron drift pins. The floors were fastened to the keelsons with vertical 1" iron drifts.

The illustrations show the wreckage as viewed directly from above (unless specified) with the fastening patterns only partially depicted for clarity. Where possible, wreckage with an original vertical orientation, such as the vessel's sides, is depicted with the sheerline at the top of the drawing. Larger section have been split into forward and aft sections to maintain detail and scale.

The bilge ceiling is completely missing from D, but surviving fastenings indicate its placement over the floors and futtocks. Several strakes of exterior planking survive. The garboard and bottom strakes were found to be of stout dimensions: 1' 3" wide and 2" thick. The *Fleetwing* was well protected against the frequent groundings which marred many lake schooners' careers.

As seen in cross-section, the *Fleetwing* had great longitudinal strength, evidenced by her pyramid of eight keelsons. These members formed a thick spine to prevent the vessel from hogging, and allowed her to carry heavy cargoes. They also absorbed the lateral stress imparted by the schooner rig and allowed the keel to be pierced for a centerboard without weakening the hull. Of an original 136' vessel length, 106' of the keelson assembly survives.

Three mast steps were found on section D, though the mizzen step appears to have been a later addition. The 1881 enrollment for the *Fleetwing* indicates that she had two masts, yet an 1887 photograph reputed to be of the *Fleetwing* and a later account (Frederickson and Frederickson 1963:69-70) indicate that she had three. It is unclear whether the mizzen is the result of a later rerigging, or if the photograph is of another vessel. Possibly, the step supported a stanchion for heavy overhead machinery, such as a donkey engine. This problem is to be the focus of additional investigation.

A very interesting feature of D is its centerboard trunk. Though common on lake schooners, these have little historical or archaeological evidence to document their construction. The rider and sister keelsons form the lower sides of the trunk, which pierces the keel for passage of the centerboard into the water. The trunk prevents the floors from passing under the keelson, therefore half floors were utilized. These were butted into notches along the sides of the trunk and fastened to the sister keelsons. The loss of the exterior planking and the bilge ceiling on D has caused the half floors in the centerboard area to come free. Only three of these half floor sets survive, living a precarious existence with ice and looters.

The cause of the intricate trunk construction was discovered ninety-seven feet off the vessel's starboard side. Section X was identified as the vessel's centerboard, uprooted from the trunk and tossed away on its side. Diagnostic details included a pivot hole, slightly beveled lower edge, and lifting holes on the corner opposite the pivot. The centerboard was edge-joined with long iron drift pins which are beginning to loosen, indeed, the leading edge in front of the pivot seems to be missing. The lack of fastenings from deck beams or cross members rule it out as being a portion of decking or a hatch. In addition, its length was found to match neatly with the trunk length on D.

Slightly overlapping the centerboard is a segment of the vessel's port side, section A. The flush frame endings distinguish the original sheerline, and the 4"/5" pattern of frames indicated this piece;s original location. The frames, like the floors, were sawn, as opposed to compass timber frames from the limbs of trees. The wood type form which the hull was constructed is not known at present, though it was most probably white oak. Future work on the site may include wood sampling of the major structural members to ascertain the types of wood used. Evidence of a possible wrecking patch was found on the exterior of five frame sets on A. The curve of the frames at this point indicate that the patch was placed at the turn of the bilges, near the vessel's bottom. Here, two logs were found nailed to the frames, in place of the exterior planking. This appears to have been a hasty log patch nailed over a puncture from grounding, perhaps an effort by the crew of the *Spalding*. Comparative evidence (Hirthe and Hirthe 1986:8-9) suggests that these patches were a common expedient used by wrecking tugs when trying to pump out a stranded vessel.

The identification of sections B and C proved rather troublesome, and were thought at first to be portions of another vessel. Rather similar in appearance, the two pieces lay near each other on a sand bottom in approximately eighteen feet of water. Positive identification was not made until water jetting (the only use of excavation equipment on the site) exposed critical construction details, such as

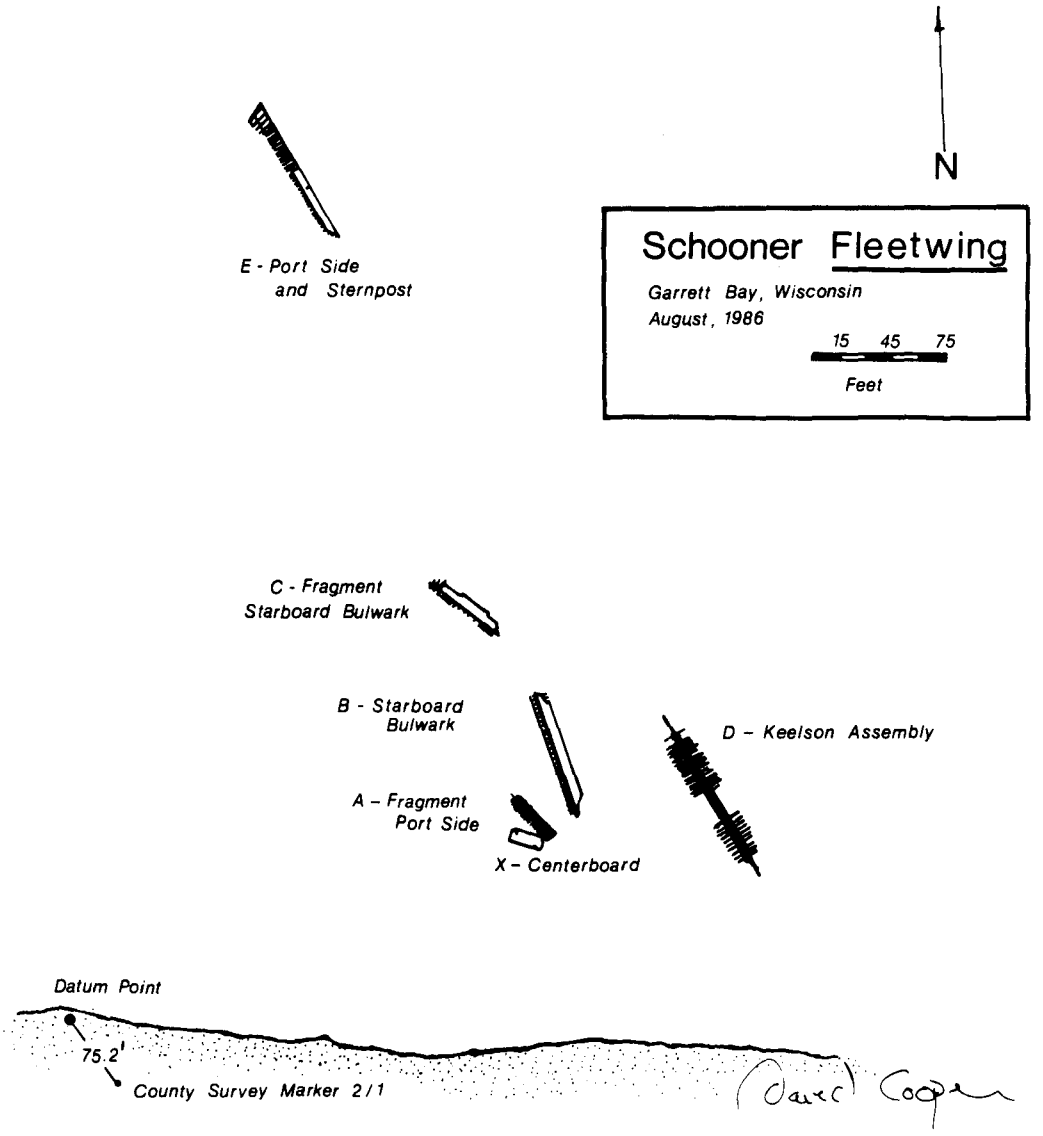


FIGURE 2. Wreck scatter

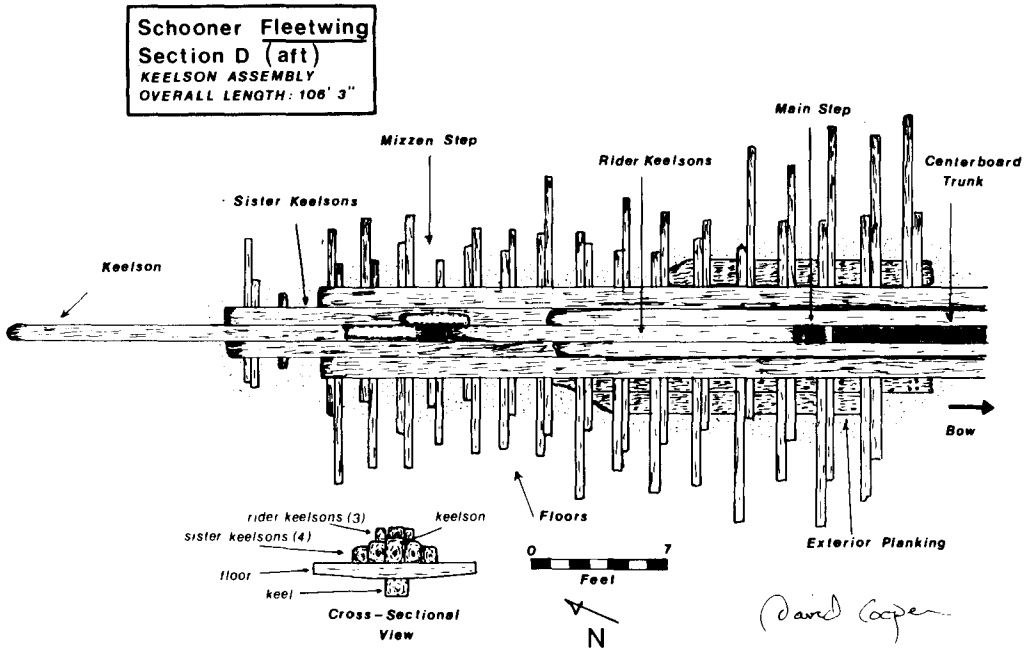


FIGURE 3.

a chainplate, bulwark, and the deck beam clamps and shelves.

The jetting revealed B and C to be surviving portions of the Fleetwing's upper starboard side, which had broken free from D and settled face down on the sand, much like A. The jetted overburden was replaced after examination of the wreckage in an effort to disturb the site as little as possible. Together, starboard sections B and C constitute a surviving 127' of the original 136' length of the *Fleetwing*.

The surviving scuppers and chainplate confirm that B and C include portions of the *Fleetwing's* bulwark. Here the frames end flush at the sheerline, with the deck beam shelves placed over the ends of the upper futtocks. The deck shelf notches indicate the original placement of the missing deck beams. Bulwark stanchions carried under the deck beam shelves and supported the bulwark, which was planked on both sides, and topped with a rail cap.

Section E is located on a rocky bottom mixed with grey and pink clay in twenty-five feet of water. The largest of the outlying pieces of wreckage, it is also the most far flung. This is believed to be a large section of the vessel's port side and stem, probably dragged away from section D by retreating pack ice. The surviving sternpost, framing pattern, sheerline, chainplate, and hanging knee helped identify this piece. Together with section A, 127' of the schooner's port side survives.

The hanging knee on E is the only extant piece of compass timber on the vessel. The chainplate location suggests that it held a backstay for the foremast. The chainplate overlaps a disarticulated piece of bilge ceiling.

By far the most interesting feature of E is the sternpost and transom assembly. Insufficient time and a dwindling air supply did not permit for more than a cursory examination, and some additional work should be done here. Identification of the sternpost was made form the rudder gudgeon strap marks. Additional details include the plank rabbet, a mortise joint for the keel, cant frames, and a hole possibly for a towing haswer. The sternpost was surprisingly crude for so well built a ship, and may be the result of a later rebuilding.

Conclusions

Taken as a whole, the *Fleetwing* wreckage constitutes an interesting data base for lake schooner construction. The scattered nature of the site exposes many construction details, and provides a jigsaw puzzle view of Great Lakes sites formational processes. The vessel construction indicates the solid manner in which these schooners were built, and demonstrates the exclusive use of iron fastenings even in an all wood hull. The *Fleetwing*, though said to be an especially staunch and attractive vessel (Manitowoc Pilot 1867) appears to have been typical of many other lake schooners in size, construction, and use.

These vessels were not constructed haphazardly by backwoods builders, but were built sturdily, with particular attention paid to the practicalities of lake commerce, and the requirements of specific cargoes. The regularity of the *Fleetwing's* fastening pattern and the use of standard dimension sawn frames and members indicates a standardization and industrialization in the Great Lakes wooden shipbuilding industry at least as early as the Civil War.

Wooden hulls would continue to be constructed, but industrialization saw its primary application in the schooner's greatest competitors, steamships and railways. An early death saved the *Fleetwing* from undignified service as a schooner barge or a last trip to the boneyard at Sturgeon Bay.

Although there was no single feature indicating the wreckage to be definitely that of the *Fleetwing*, it is highly probable. Local residents are quite familiar with the wreck and know it by name. The grandson of Andrew Nelson confirmed the vessel's location, and was the first to express doubt at the hypothesis of two wrecks being located off the boat landing. All the wreckage found by the 1986 survey has been identified as that of a single vessel.

The archaeological investigation has indicated nothing contrary regarding the identification of the wreck. The wreck's dimensions are within with her enrollment dimensions. Though length and beam dimensions can only be guessed due to the scattered, flattened hull, the depth of hold can be estimated from the width of side sections A and E. They are in fact within a foot of her original depth, even after having been torn free of the keelson section.

Identification of the sections was based on evidence provided by framing patterns, dimensions, and what was believed to be the sternpost. In its disarticulated form, the identity of the wreckage's original orientation and function can only be considered the best interpretation at present. An alternate interpretation is currently being considered with a new examination of the field data.

Future Investigations

In the course of documenting the surviving remnants of the *Fleetwing*, a number of basic questions were answered about her construction. Of course, many new questions remain to be addressed, and should be the subject of future investigations. Specific details such as the mast steps, the types of wood used in her construction, and section E warrant more in-depth examination. Presently, an interpretive study of the *Fleetwing* is being undertaken including historical and archaeological sources to better understand her use in Great Lakes commerce, especially the grain and lumber trades.

Additional survey work could reveal more wreckage in the deeper water north of section D, such as the missing decking. Use of side scan sonar and a magnetometric would facilitate such a search. Future documentation of the site should also include underwater photography.

Though the problems of looting are irreversible, an effort could be made to locate and study material removed from the wreck to form a more rounded picture of the site. A curb to future looting on all underwater sites in Wisconsin necessitates a more active program in submerged cultural resource preservation. This would require more explicit protective legislation and enforcement, a submerged site survey program, and efforts at public education.

Such surveys as the *Fleetwing* project have merit in their brevity and low expense, while still producing a sizeable data base. Underwater surveys are beneficial to both academic and cultural resources management projects, and should become more of a priority to the Great Lake states, with their rich but inadequately documented maritime heritage.

REFERENCES

CHAPELLE, HOWARD I.
1982 *The History of American Sailing Ships.* Bonanza Books, New York

CUTHBERTSON, GEORGE
1931 *Freshwater; A History and Narrative of the Great Lakes.* Macmillan Company, New York.

FREDRICKESON, ARTHUR C. and LUCY F.
1963 *Ships and Shipwrecks in Door County*, Wisconsin, (II). Door County Publishing Co., Sturgeon Bay, Wisconsin.

HIRTHE, WALTER M. and MARY K.
1986 *Schooner Days in Door County.* Voyageur Press, Minneapolis.

ELLIS, WILLIAM
1969 Wisconsin's Door Peninsula. *National Geographic* 135 (3); 357-359. Washington, D.C.

PAASCH, H.
1890 *Illustrated Marine Encyclopedia.* Reprint 1977. Argus Books, Ltd., Watford.

U.S. NATIONAL ARCHIVES
1872 Enrollment 90, Port of Chicago.

1881 Enrollment 144, Port of Chicago.

NEWSPAPERS:
Door County Advocate, 25(9) 1886

Door County Advocate, 27(24) 1888

Manitowoc Pilot, 8(39) 1867

Manitowoc Pilot, 9(4) 1867

DAVID J. COOPER
PROGRAM IN MARITIME HISTORY AND UNDERWATER RESEARCH
DEPARTMENT OF HISTORY

SYMPOSIUM

MICHAEL ROBERTS

The Site Testing Program for the Pirate Ship *Whydah*

Professional archaeological study of the pirate ship *Whydah* has been in progress for three years. Despite this, the investigation is still in its infancy. In 1986, we completed the testing phase of the project; currently we are developing the research design and data-recovery plan for the next several years of the project's expected life. Professional archaeologists, historians, and conservators have participated in the exploration, evaluation and testing of the wreck site since 1984 (Figure 1).

One of the challenges of the project is the building of a project team that can not only formulate and implement a scientifically valid research program but also meet the needs of the project sponsor and the several regulatory bodies having jurisdiction over the project. One distinct advantage in this project has been the commitment of the sponsor, Maritime Explorations, Inc., to meeting professional and regulatory requirements for recovery, conservation, and scientific reporting of the project's results.

A second challenge is the development of sound recovery, conservation, analysis, and curation methods in an environmentally hazardous field situation, using a mix of professional archaeologists, professional salvage divers, professional laboratory staff and volunteer laboratory assistants.

And the largest challenge of all is meeting project goals in the face of peer suspicion, sponsor paranoia, and idiosyncratic funding.

Nevertheless, these challenges are being met, and we are confident that we will begin the data-recovery phase of the project with valid procedures implemented by an experienced and qualified team within a scientifically appropriate research design, which will reveal a little-known element of the past to our scientific peers as well as to the general public.

The Project

Since its earliest days, the project has functioned under permits from the Massachusetts Board of Underwater Archaeological Resources. It was the first project of its kind to come before the Board and, as was to be expected, misunderstandings and misinterpretations were fairly common in the early days. As the project developed, so did the expertise and experience of the Board members as well as the permittee.

Before this time, the Board had not had any formal regulations. The current regulations were actually written and accepted during the early days of the project. It was also a period when the Board and the

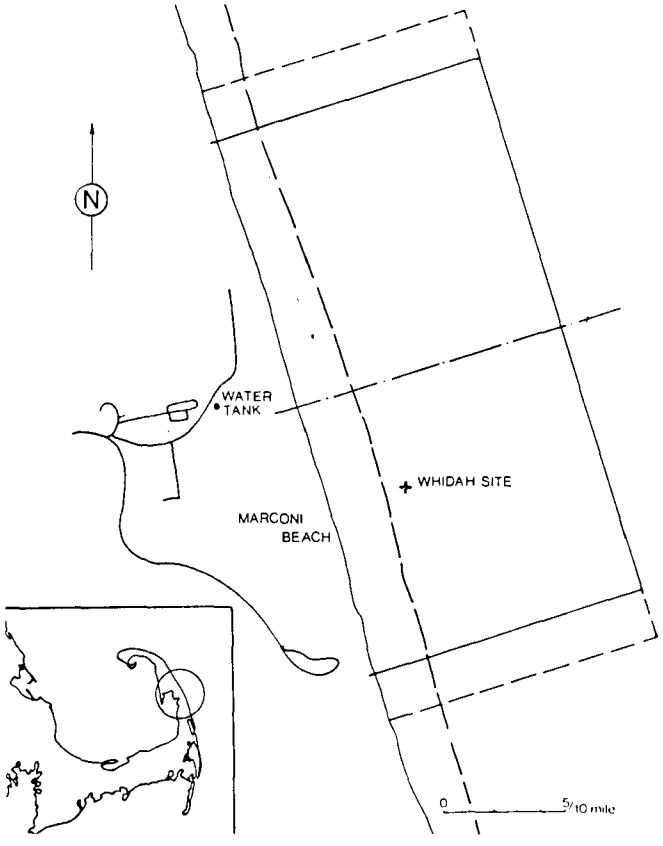


FIGURE 1. Location of artifact concentration from the *Whydah*. Note location of 1717 shoreline (dashed line)

various permittees currently exploring or otherwise working in Massachusetts waters were required to reach a mutual understanding of philosophical and practical matters.

1984

Controlled scientific examination of the project area began late in the 1984 field season. A team of professional archaeologists continued the detailed exploration carried out over the previous several years. The archaeologists were retained because after several years of exploration Barry Clifford, president of Maritime, was convinced that he had located the original wreck site. In his own words, he "had a tiger by the tail," and recognized his need for professional assistance if he were to meet the requirements of the Massachusetts Underwater Board. Using as preliminary goals the determination of the physical extent of the site, the identification of the discovered wreck, the physical nature of the site, and the testing of various field techniques, we started work in September of 1984. Two test units were opened in that year, using several approaches to the excavation process.

In addition, a detailed magnetometer survey was conducted by Ocean Surveys and a preliminary subbottom profile survey was done by Klein Associates.

Analysis of the year's activities led to some preliminary conclusions about the site. First was that the distribution of material resulting from the original wreck was most probably controlled by storm and current forces during and after the wreck, leaving a roughly fan-shaped pattern radiating from the original wreck location.

Second, the analysis of recovered material provided strong circumstantial evidence that the wreck site was indeed that of the *Whydah* This evidence included dates from 656 datable coins as well as date ranges from recovered weapons and weapons parts. Finally it was clear that we needed better excavation procedures than those employed in 1984.

1985

As plans for 1985 were developing, it was clear that any excavations procedures used would require the issuance of a Crops of Engineers permit. In addition, we considered that the site was potentially eligible for inclusion in the National Register of Historic Places. These two facts led us to submit documentation to the Corps and the Massachusetts SHPO for a determination of eligibility and a preliminary case report.

The site was determined eligible and the 106 process was implemented, with the result that the Corps issued a permit that had attached to it a Memo of Agreement between the Corps, the Mass. SHPO, the Advisory Council, and Maritime Explorations.

The result of this action was that not only the state regulatory process but also the federal process became involved with the project, all with the complete agreement and cooperation of the project sponsor. In accordance with the Memo of Agreement, a comprehensive preliminary data-recovery plan was developed. Since the 1984 goals had not been met, it was necessary to develop a detailed testing plan to achieve the original goals referred to above, which would then allow us to prepare a final data-recovery plan.

Ultimately, this plan was in three phases. Phase I deals with additional survey and preparation for data recovery. Phase II is the development of the data-recovery and public-benefit programs. Phase III is the implementation of the data-recovery and public benefit programs.

Drawing on the results of the 1984 work and other research, a model for site formation was developed and used in establishing and testing strategies. This model recognizes the fan-shaped distribution hypothesized in 1984 and adds to this notion observations on the geomorphology and nature of the sand bottom (figure 2). Essentially, after the initial wreck and breakup (documented by an observer of the wreck), the liquid nature of the sand sheet and subsequent storm history controlled further distribution of the material.

Concretions of any size began settling within the sand sheet as they were forming, roughly where initially deposited. Smaller iron masses and isolated artifacts drifted within the sand sheet with their descent trajectories roughly determined by their mass or specific gravity (figure 3). As the objects reached the clay base, the morphology of the substrate began to influence their distribution. Pits, crevasses, ledges, and other bottom forms tended to concentrate material as it was moved by the sand sheet under the influence of longshore currents, storms, and other factors (figure 4).

To test this model, a series of test unit transects was laid out across the site using a point within the area of principal concentration discovered in 1984 (termed Point A) as the reference point. Twelve systematic and three judgmental 8 foot by 16 foot test pits were requested from and authorized by the Massachusetts Underwater Board.

Other elements of Phase I of the Preliminary data-recovery plan include:

1. concentrated historical research
2. the development of excavation and computerized recording systems
3. laboratory support
4. conservation support
5. geophysical research into offshore dynamics, and
6. a final report on Phase I and its results

Considerable time was expended in the permit applications process. This, coupled with severe weather conditions, limited the field work for the 1985 season, when only three test units were completed. These units, however, were quite productive, yielding over 4,000 objects representing twenty different material types.

In addition, one of our principal research questions was answered during this year. While working in one of the systematic test units, we discovered what appeared to be a ship's bell. A test unit was placed at its location and the bell, as well as other material, was recovered. The bell was highly concreted and several weeks were devoted to reducing this concretion under the direction of Betty Seifert.

Reduction revealed the inscription "The Whydah Gally 1716". Our only disappointment was that we had been spelling it W-h-i-d-a-h for the past several years and we had to order new "T" shirts. There was also a race among the crew to be the one to get the vanity license plate with the proper spelling (Barry was not the winner).

With the discovery of the bell, effort that had originally been targeted on analysis of materials for identification of the wreck was redirected toward other research.

The other significant event of 1985 was the development of operating procedures for field and lab activities. The purpose of these procedures was to eliminate the effects of changing personnel over the course of the expected data-recovery period (currently anticipated to be five years), as well as to provide standard operating orders for the dive team, who are not all trained archaeologists.

The field-test procedures identify four levels of documentation for each test unit. Level one documents the large objects, greater than four feet in length or diameter. Level two documents the location of smaller objects, that are larger than the 1 foot square primary provenience units. At level three, objects smaller than one foot are collected and documented by the number of the provenience unit.

The final documentation is the mapping of the bottom topography.

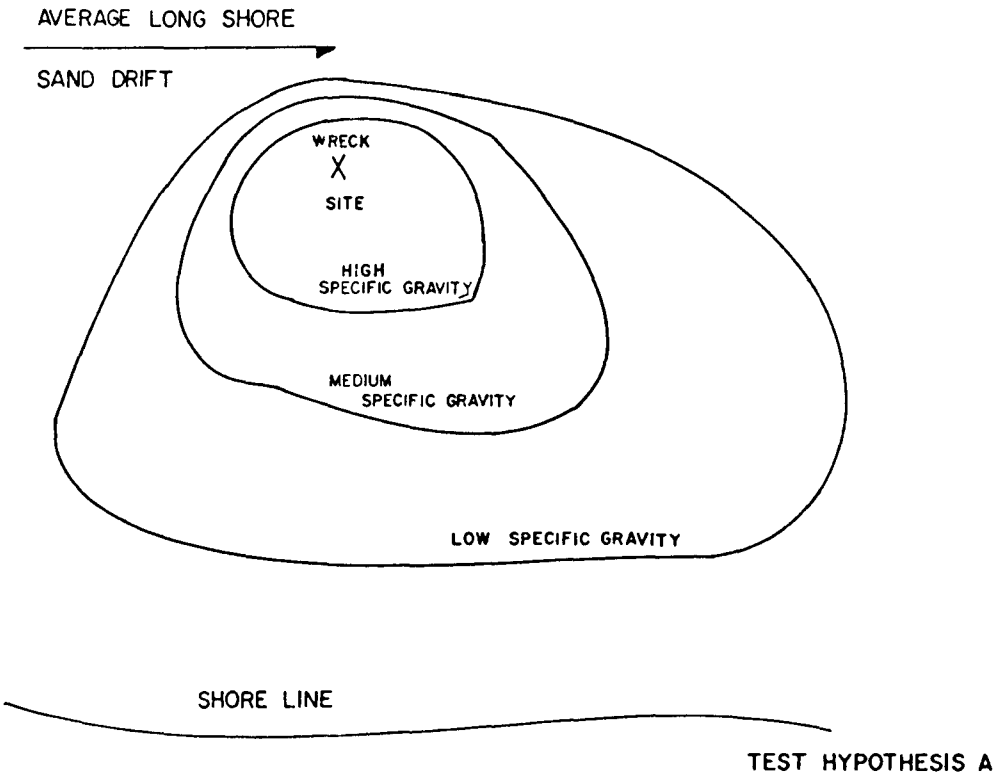


FIGURE 2. 1717 Wreck distribution

This is done to aid in testing our distribution hypothesis.These procedures have subsequently been perfected by our field archaeologist in the 1986 field season and will be discussed in his paper. Other procedures developed in 1985 were those for concretion reduction, documentation in the vault, and field inventory and preliminary catalogue.

1986

In 1986 we completed all the originally planned systematic test units and several of the judgmental units. Enough to feel confident that we understand the nature of the primary wreck site, its location and its integrity. Analysis is proceeding with respect to our test hypothesis and will be reported on in our final report for the testing phase.

In addition to completing these units, we commissioned a pilot study of historic resources in Britain that has given us a valuable planning tool for future work. This study will be reported on by Anne Turner. Concretions and their reduction and documentation was the biggest developmental challenge of 1986.

It became clear in 1985 that the artifact associations locked up in concretions were probably the closest we were going to get to actual associations on ship board or immediately after the wreck. Thus, it was important to develop reduction and documentation procedures that would accurately recover these associations. Louise DeCesare our lab supervisor has been developing and testing these procedures and will report on this aspect of our lab activity.

One of the most interesting and technically challenging of the concretions is a bag of artifacts.
So far mostly weapons parts but potentially one individuals personal belongs. This object presents a distinct challenge to our conservator Betty Seifert due to the wide range of materials represented as well as the fragile nature of many of them. Her activities will also be reported here.

We have also begun using an industrial X-ray firm to help us locate and identify objects within many of the concretions. Finally,

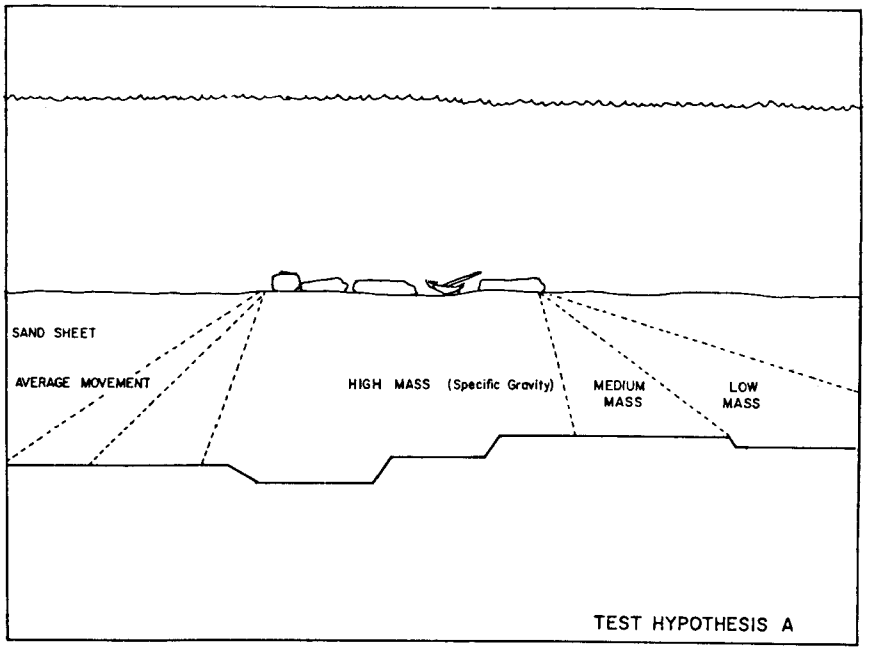


FIGURE 3. Distribution of material within sand sheet

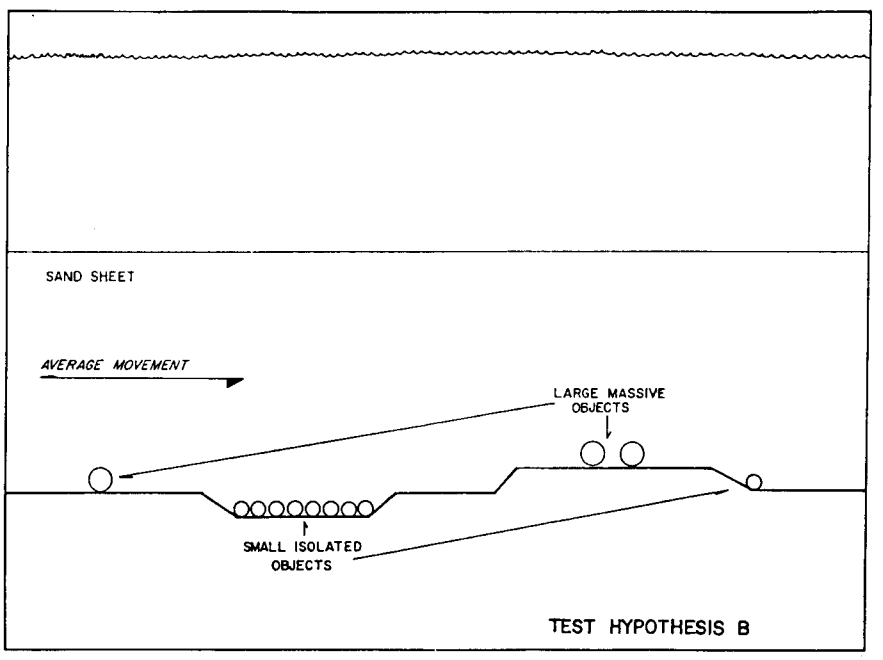


FIGURE 4. Distribution of objects in pits

geologist Bill Marshall is developing a work plan for sampling and analysis of the ship's ballast.

Wrap Up

We move into 1987 with a good knowledge of the range of materials to be encountered, the location and nature of the primary wreck site, processing procedures and time lines in place, a functioning lab and preliminary conservation facility, and an experienced dive team and boat crew.

Our next tasks are the completion of testing phase analysis, the development of a research design for data recovery and the establishment of several public-benefit programs which will include teacher training, internships and a newsletter.

We also have a scientifically interesting and technically challenging site, one which we hope to report to you as work progresses over the next several years.

MICHAEL ROBERTS
TIMELINES, INC.
51 HOLLIS STREET
GROTON, MA. 01450

K. ANNE TURNER

The Historical Research of the British Archives for the *Whydah* Ship Project, Massachusetts

Introduction

Initial research on the historical data related to the *Whydah* site was undertaken in Britain for one week at the beginning of 1986. This phase of research revealed some important data on the ship and its personnel, and a wealth of potential information for future study.

This paper describes the process of and results from this research in the British archives, undertaken by Research International, a British-based research company specializing in retrieval of historical and archaeological data. It also demonstrates the value of locally knowledgeable researchers in expediting the research process.

The *Whydah* was a slave ship. To be more specific, the ship's bell, excavated last year, named the vessel a galley. The ship travelled from London, England to Guinea on the West Coast of Africa, where it collected slaves. It then continued to the Caribbean to unload its human cargo. The *Whydah* returned to England with Caribbean raw materials. This triangular route was common for slave ships of the seventeenth and eighteenth centuries.

It is essential for the excavation of a vessel as romantic as the *Whydah* that sentimentalism and folklore do not obscure the historical facts and hinder the project as a whole from communicating those facts to the professional and general public. History is not quaint, but it can be stimulating. A historian should have good instincts, be unbiased and his or her work be as exhaustive and accurate as possible. This demands a huge time commitment and expense, but is essential if a project is to move from the realms of folklore or salvage to accurate historical reconstruction. Folklore is not necessarily at odds with historical archaeology, but a distinction must be made between folklore and historical fact. Detailed historical research alone can distinguish fact from fiction, because the historical record can help reconstruct the actual events. Once the historical data has been gathered, analysis of the primary sources, archaeological data, and folk studies can be undertaken.

Aims

The aims of the historical research were twofold: first, to locate as much information as possible on the *Whydah* site from the archives located in the United Kingdom; and second, to undertake a preliminary survey of archives available in order to make recommendations for future research.

Due to time constraints, research requirements were set out in order of priority as follows:

1. archives related to the ship
2. archives related to Captain Lawrence Prince, Captain of the *Whydah*
3. archives related to Samuel Bellamy, leader of the pirates who stole the *Whydah*
4. further information on specific artifacts retrieved from the *Whydah* site.

Methodology

The research took place in four major archive centers in or near London: the Public Records Offices at Chancery Lane and the modern branch at Kew, the Guildhall Library (the City of London's local library) and the National Maritime Museum, Greenwich. Before embarking on the research, I met with members of the project to discuss what research, if any, had been done to date, what the priorities were for this trip, and if there were any specific documents I should begin with before going through the usual procedure for historical research (searching through indexes, directories and so forth).

A number of individuals have undertaken historical research in the Massachusetts State Archives and other libraries and archive centers in New England. Some years ago, Edwin Dethlefsen did some preliminary work in England. However, his brief report was very general and clearly there was need for a more in-depth study of the archives stored in the British Isles.

General reading had led some members of the team to require a review of specific documents thought to contain relevant data. Therefore, my first task was to pursue this lead. I was also advised that the *Whydah* may have been owned by the government operated Royal Africa Company, Britain's largest shipping company in the early eighteenth century.

The specific documents for review and the suggestion to check into the possibility of government ownership of the *Whydah* meant that the best place to begin research was the Public Records Office, Kew.

Three days were not enough time to cover all potential sources, so a thorough list of all potentially significant documents was compiled. They should be reviewed at some point during the project. From this list I then selected those documents which seemed would profit the most information in the short time available.

Results

Results determined that the Royal Africa Company did not own the *Whydah*. During the course of the research, a substantial amount of general information concerning conditions on board slave galleys, salaries paid by the Royal Africa Company, and much more was located. This data will be useful for comparative analysis once additional data on the *Whydah* is obtained.

The Calendar of State Papers 1716-1717 mentions that the *Widdaw* was owned by "Bristol." This reference may be to the Marquis or Earl of Bristol, or the City of Bristol. The latter is more likely, because Bristol's wealth was partially based on the shipping and slave trades. But, as so often happens with historical research, this information was discovered one day prior to leaving. As a result the Bristol reference will need to be pursued at a future date.

The Calendar of State Papers, also included letters from Governors and British officials of the Council of Trade and Plantations (the former Board of Trade) on the Caribbean colony islands. These letters facilitate tracing the activities of the *Whydah*; its captain and the pirate captain Samuel Bellamy.

One example is a letter from one Habbjah Savage informing the Council that Abijah Savage, Commander of the sloop *Bonetta* of Antigua, lost his ship to Samuel Bellamy who was on the *Mary Anne*. The letter stated that Bellamy had declared himself to be an Englishman born in London. This is a useful indicator for embarking on genealogical research.

Another example is a letter sent to the Council of Trade and Plantations from Lieutenant Governor Spotswood on May 31, 1717. The letter informed the Council that on April 7 of the same year the ship *Agnis* of Glasgow was taken and sunk by Bellamy five leagues off Cape Charles.

As one might expect, the details contained in these correspondences do not always match perfectly, but the combined data aid the researcher to construct an accurate picture of the ship's and pirates; movements prior to the final sinking of the *Whydah*.

Some other informative documents were Jamaican port records. It was frustrating to find that no records were kept from April 1714 to March 1718, and the records for 1720-21 were missing. It is very possible that these periods may be covered in the local archives in Jamaica.

Unfortunately, the Port of London records describing the names of ships and their masters, names of merchants and a description of goods imported and exported for the period 1715 to 1799 were destroyed by the Act of Statutes, Rules and Schedules Governing Disposal of Public Records in the late nineteenth century. Books 11A and B escaped destruction. These, however, were mostly illegible due to poor storage conditions at the old Public Records Office, Chancery Lane. It is possible that there are similar records still with the Port of London Authority. As yet, no records of a report of the ship's theft have been found among the High Court of Admiralty documents. Captain Prince would have had to prepare a written report of the ship's loss. However, if the ship was owned by the City of Bristol, this record, if it does still exist, will probably be in Bristol.

At the Guildhall Library and the National Maritime Museum, there was little relevant primary data, mostly secondary sources. But the source material and the librarians at these centers provided further leads to follow up on, such as the Business Archives Council.

At the National Maritime Museum, there was a great deal of general information on ships, the shipping trade and so forth, as one would expect. However, all records of ownership, Port Books etc. have been forwarded to the Public Records Office while all company records are in the possession of the individual companies or cities. The museum has maintained a small file on all correspondence and other miscellaneous information on the *Whydah*. Although the file did not contain any important information, it was interesting to see how long there has been interest in this ship. One piece of correspondence, from Andover, Massachusetts, dated to 1973.

One exciting reference I came across at the National Maritime Museum was to "Lloyd's News" which supposedly began publication in 1696; this predated the Lloyd's List by 38 years. "Lloyd's News" contains details of shipping movements. Surprisingly the paper was not at the Museum. Copies may exist at the British Museum Library, the British Museum Newspaper Library and the Bodleian Library, Oxford. If this "newspaper" still survives, it could be an invaluable source of information not only for this project, but for any underwater excavation of a British ship predating Lloyd's List.

Two factors demanded extreme caution when doing this research. One is the prevalence of the name *Whydah*. There were a number known by the same name in the seventeenth and eighteenth centuries. All were named after the large West African slave town, Ouidah.

The other area for caution involves the various spellings of *Whydah*, of which there are at least five, (Whidan, Widaw, Widah, Ouidah or Ouida). These spelling variations can indicate different ships of the same name, or the same vessel.

Until the ownership of the *Whydah* is established, the type, dimensions, and other details on the ship's structure remain unknown. However, there are plans for Research International to continue the next phase of research immediately following this conference.

Recommendations

An extensive list of specific documents recommended for review was included in the report submitted to Maritime Explorations, Inc.

The Bristol archive centers are certainly the priority for the next stage in the research. The Port of London Authority, as mentioned above, should have relevant information on ships passing through London. So, too, should her Majesty's Customs and Excise Library, which contains archives on trading and shipping statistics, Books of Rates, tax of goods, smuggling and so forth.

It is important to track down the "Lloyd's News," probably at the British Museum or Bodleian Libraries. At the same time other potentially relevant documentation on the eighteenth century shipping and slave trades known to be among their collections should be reviewed.

Port records in the Public Records Office in Spanish Town, Jamaica, should be examined because of the absence of these records from Kingston, Jamaica for 1714-18 in the British archives.

Contact with the British Business Archives Council and the London Search Room, Companies House will be necessary if further research shows that ownership by Bristol does not mean the city but a private individual or company.

Additional research is needed at the Public Records Office, Kew, to further examine the Colonial Office and Board of Trade records, the Port Books for Bristol and Customs Ledgers Class Lists.

Finally, it is advisable to review the archives at the Institute of chartered Shipbrokers.

Conclusions

Much has been said, both privately and publicly about professional archaeologists and historians working alongside salvage crews. Many purists refuse to accept "compromise." But what does that mean —what are we compromising? No one would dispute that the highest professional standards have to be maintained with all projects.

It is only by involvement with such underwater excavations as the *Whydah* that archaeologists and historians can influence the quality and professionalism of the task at hand, and also help dispel an "us-and-them" mentality which ultimately adds to the competitive relationship between salvor and professional. As a result many precious features of our heritage would be lost. Salvage groups are here to stay, and only through close communication, education and research is there a possibility of a future of cooperation and improved standards of excavation and historical research, rather than competition and thence destruction.

Research International is a British-based professional research company. We work with historians, contract archaeologists, genealogists and other individuals interested in retrieving information from the British archives. We have the knowledge and facilities to advise an individual undertaking their own research in the British Isles, retrieve one specific document or undertake more extensive research for larger projects, such as the *Whydah*.

One of the biggest problems which face projects of British American sites in the United States is obtaining historical data stored in the United Kingdom. The problems are many-fold. The sheer cost of sending a researcher to Britain - air fare, hotel and living expenses and internal travel - can make a trip prohibitively expensive. Also, lack of familiarity with the numerous archive centers can hinder progress.

Research International has many features to enable speedy and accurate retrieval of historical data from the United Kingdom. Ready access to the centers, knowledge of the location of specific types of documents and of the cataloging system within these centers speeds up the research process, thus saving the project much time and therefore, money.

Also, with a researcher who has experience and training in both Britain and the United States, there is a familiarity with the two "languages" and "schools of thought" of the Old and New Worlds. This factor is crucial for good communication of the project's needs and the value of the report on historical research. The historical research which began this year in the United Kingdom will continue to enhance our understanding of the ship itself and the events involved in its life.

Once the raw data has been gathered the potential for extensive analysis and synthesis will provide answers to many questions about the role of the *Whydah* in a local, national and international context.

K. Anne Turner
Research International
50 Davis Avenue
Brookline, MA 02146

BETTY L. SEIFERT

Conservation of a Complex Composite in a Dense Matrix of Concretion

Underwater sites with much iron present are filled with concretions which enclose many different types of artifacts with the degrading iron. The degrading iron forms a dense matrix with minerals from the sea in a complex chemical and electrolytic process which has been described by D.L. Hamilton in his publication, *Conservation of Metal Objects from Underwater Sites: A Study in Methods*. The concretions formed at this site are very dense and hard, some what like prestressed concrete.

Composites are objects composed of more than one material, usually wood and metal, bone and metal, and other combinations all of which present difficult treatment problems. Treatments for the stabilization of very different materials are incompatible and usually harmful to the other material. In this case, a large, rocklike concretion was recovered.

Bag Concretion

This concretion was relatively flat and lumpy. X-ray analysis at the local dental laboratory showed a hodge podge of small indistinguishable objects. Initial attempts to begin opening this concretion mechanically revealed a layer of fabric, a canvas, which was completely imbedded in the concretion. The fabric was hard and brittle with concretion impregnating the fibers. Attempts to remove the concretion produced fractures in the fabric.

It was decided to x-ray the concretion again. This was done at Arnold Green Testing Laboratories. This x-ray revealed much more detail. It appeared to be a bag full of gun parts—locks, frizzens, screws, side plates, trigger guards, etc. These parts would normally be iron or copper alloy. There were also many unidentifiable artifacts all in a jumble.

Due to the hardness of the concretion, its firm grip on the textile and the complexity of the assemblage, a decision was reached to attempt to remove or soften the concretion by electrolysis. This treatment, though a bit radical, was initiated with careful documentation and monitoring. Each step of treatment and artifact removal was carefully recorded in cooperation with Louise DeCesare, who is in charge of laboratory documentation.

Concretion Prepared for Electrolysis

Preparation for electrolysis began with the careful insertion of metal pins or probes into the concretion. Tiny holes were drilled to reach artifacts viewed in the x-rays. Metal pins inserted in these holes were attached with multistrand copper wire to a D.C. power supply. Exposed artifacts were attached with small clips. The electrolyte was a 2% NaOH (sodium hydroxide) solution (Figure 1).

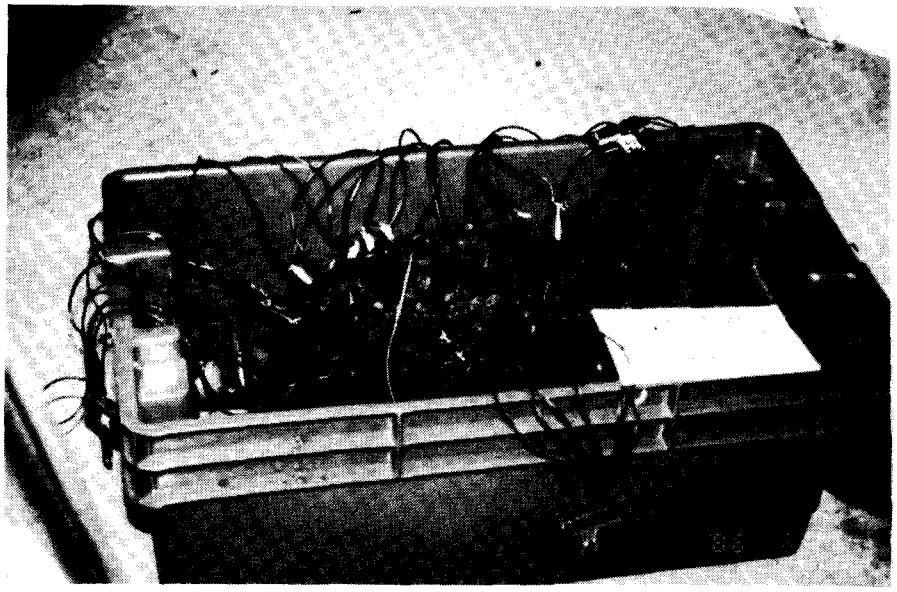


FIGURE 1. Concretion prepared for electrolysis

Electrolysis

Electrolysis was run at 2 amps for a month with several changes of solution and careful monitoring. As the concretion began coming away in areas and fragile fabric was exposed, it was decided to wash the concretion and resume mechanical picking.

Reduction of the concretion proceeded slowly but with more ease than before. Eventually it was possible to remove the fragmented top layer of textile from the concretion. It was sewn into net for further treatment. The artifacts inside the textile have also been difficult to remove. The artifacts are fragile and thoroughly tangled like snarled yarn. Some artifacts exist only as a mold in the concretion.

Concretion Reduction

The concretion has been removed carefully in small overall increments and each bit of concretion examined closely as some artifacts are tiny such as bird shot, a tiny bead, and small bits of rosin. Each layer of excavation has been documented in a 1:1 drawing and by a polysulfied rubber mold. Casts in polysulfide rubber have been made of the ghost artifacts. Photodocumentation has accompanied every step.

The process of excavating this complex group of artifacts has not been completed. To date, artifacts from this concretion have been of iron, copper alloy, lead, textile, leather, glass, rosin, bone, flint, and slate. Each of these artifacts require further treatment for stabilization.

Conclusion

This treatment has been a little like juggling—trying to keep all the artifacts healthy and well while removing them from a rapidly changing environment. Questions and problems have arisen with every step, but the chief problem has been one of maintaining equilibria. This has been done by slowing environmental processes, reducing oxidation, and keeping the artifacts cold while working carefully to remove the artifacts for individual treatment.

BETTY L. SEIFERT,
ARCHAEOLOGICAL CONSERVATION LABORATORY
PLYMPTON, MASSACHUSETTS

JAMES R. REEDY, JR.

Field Procedures Developed on WLF-HA-I the *WHYDAH* Site off Wellfleet, Cape Cod

Introduction

Field procedures developed during the testing phase of this operation evolved in response to a number of environmental, logistical and material requirements. Each of these factors affected separate aspects of the operation in different ways. The testing phase of the project was highly successful not only in that the site was investigated prior to implementation of the major excavation or "data recovery" phase, but also in affecting a viable working combination of methods that can be employed therein. Each of the several aspects of the testing phase shall be examined as they affected the development of the excavation procedures.

Environmental Situation

WLF-HA-1 is an exploded submerged cultural site lying approximately 1300 feet seaward of Marconi Beach near Wellfleet, Cape Cod, Massachusetts. Water depth varies between 20 and 30 feet, the greater depths being along the eastern or offshore boundary of the site. The sea bottom in this area consists of a highly mobile layer of coarse beach sand varying in depth from about five feet to over ten feet. Mild tidal current of up to just over one knot sweep the site in a north-south direction. Because of the shallowness of the water and the proximity of the site to the surf zone, any easterly swell results in considerable surge across the working area.

Geological stratification of the sea bottom in this region consists of the heavy blanket of coarse beach sand previously described, overlying a layer of mixed cobble, shingle and gravel ranging from 3 mm to 300 mm in diameter. This layer varies in depth and concentration throughout the site. Lying atop and interspersed with this material are the majority of the artifacts. Beneath the cobble layer the bottom is composed of extremely fine, tightly packed white or light grey sand which has thus far proven impervious to artifact penetration. A basal layer of hard clay underlies and in some instances protrudes through both the fine sand and the cobble layers (Figures 1 and 2). In some areas of the site, channels have been cut in the basal clay layer. The possibility that they are ancient glacial streambeds is currently being investigated. In the western, or shoreward areas of the site, cultural material had concentrated in these depressions.

Weather and sea conditions were the primary complicating topside environmental factors during the 1986 season. The 70-foot recovery vessel *Vast Explorer II* could not remain on station in any easterly weather of any intensity. The major impediments to progress on the site underwater were and still are the extreme mobility of the sand layer and the presence of vast amounts of drifting weed which collects in the excavations, interfering with the divers' vision and clogging the excavation equipment.

Problems

The first obstacle to the operation was the ten-foot deep layer of sand covering the site. This had to be penetrated and the artifact layer reached without disturbing the cultural material beneath. Removal methods that could be employed were limited by 1) the tremendous volume of sand that had to be disposed of, 2) the delicacy with which the operation had to be accomplished, and 3) limitations imposed by the availability of material. In addition, the looseness and mobility of the sand resulted in its tending to disguise the nature of the material in the excavation pits, and occasionally to interfere with grid layout and recovery of artifacts. All these problems had to be taken into consideration and solved before a valid plan of test excavating could be implemented.

Another problem facing the recovery team was having to recover a very large number of very small items under conditions less than conducive to doing such work entirely by hand. I refer specifically to large quantities of bird shot and smaller dust and slave shot found throughout the site, along with a considerable quantity of gold dust that had been aboard the ship. There were also a number of small pins, beads and other items virtually invisible to the naked eye.

Lastly, because of the mobile nature of the bottom material the test pits tended to fill rapidly with sand, sometimes in a matter of hours. This invariably necessitated re-excavation the next morning if not several times the same day. This problem was aggravated by virtually any weather except a flat calm. Because of this and the fact that any easterly breeze over ten knots usually meant that the recovery vessel had to seek shelter, it was necessary to be able to work as rapidly as possible to complete each individual test pit before it filled in or *Vast* was forced to pull off site.

Site Testing and Grid System

The purpose of the site testing conducted during the 1986 season had several facets. It was necessary to determine the limits of the site and to determine the locations of major artifact concentrations. In this respect 1986 was a continuation of previous seasons work. It was also necessary to develop a workable procedure for dealing with the excavation of individual test pits, the implementation of which called for the construction and testing of a number of excavation tools not previously employed on the site.

The test pit pattern consisted of twelve 8 x 16 foot pits arranged on north-south and east-west axis across the site, the two axes crossing at an arbitrarily selected datum point "A" which was assumed to be close to the center of the main dump area. Each pit was located in relation to point "A" and delineated by a grid constructed of eight-foot sections of steel reinforcing rod painted in alternating red and white stripes.

These steel grids were implemented first during 1986, replacing earlier grids which had been constructed of leaded lobster line tied to individual corner stakes. The re-bar grids proved very stable and ultimately suitable for use with the propwashing technique. The grids were easily set up, highly visible to the divers and eliminated the need for lines to be strung all over the bottom. Each 8 x 16 foot rectangle was divided into two 8 x 8 foot squares which were in turn divided into 4 x 4 foot quadrants. Each 8 x 16 consisted of a total of 128 1 x 1 foot squares, which were the basic unit for mapping and recovery.

Material was mapped as it was exposed, and was categorized as belonging to one of three levels. Level One consisted of large items such as cannon, anchors and large concretions. Level Two was that material which was considerably smaller, usually hand carryable, and which took up space in only a few squares. Level three consisted of material within an individual 1 x 1 foot square.

All mapping was done on special Tyvek forms printed specifically for this project. Only Level One and Two material was mapped in situ. Level Three material was provenienced only to a 1 x 1 foot

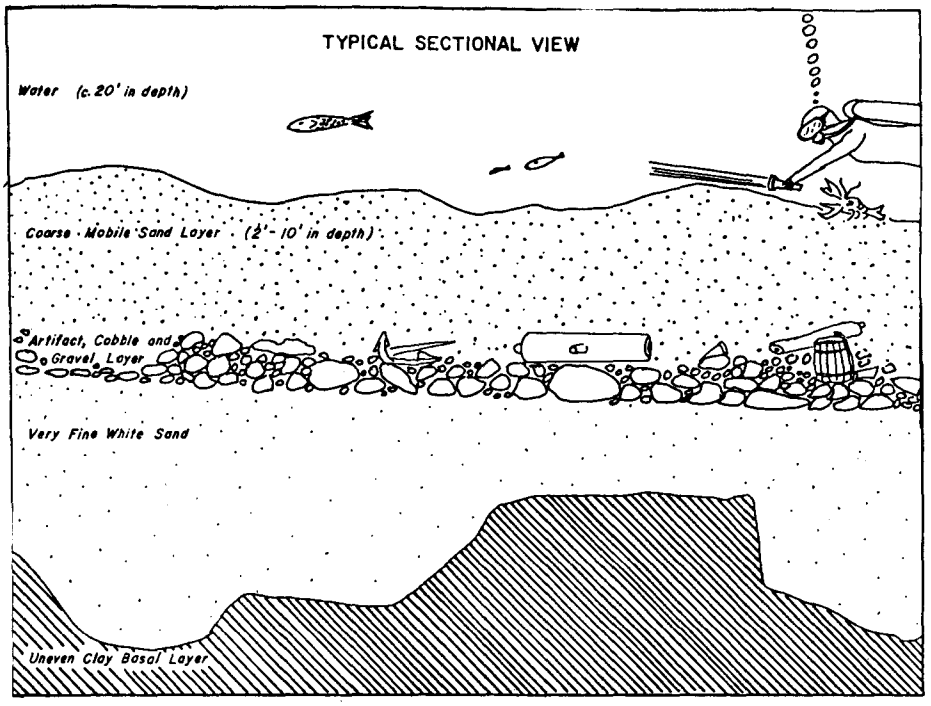


FIGURE 1.

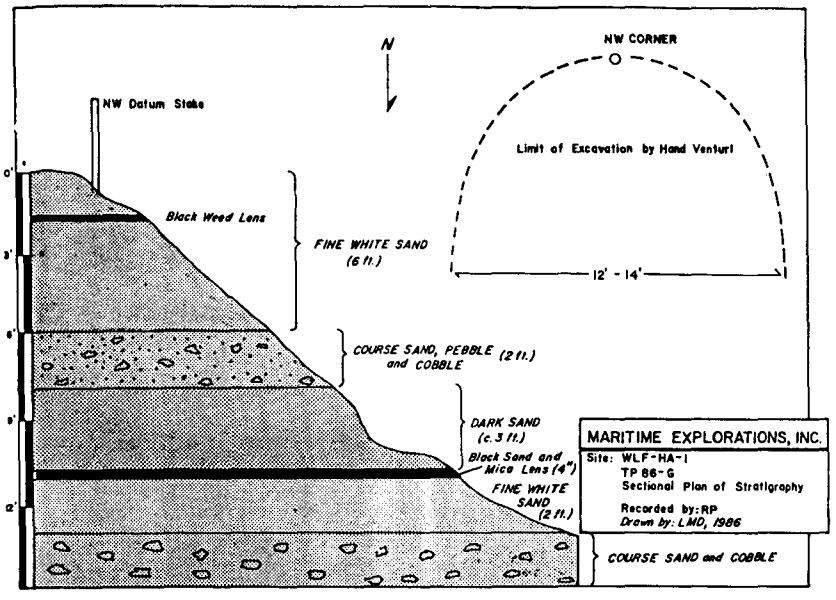


FIGURE 2.

square. Level Three recovery was performed by handpicking each 1 x 1 foot square, then airlifting the square clean with a 2-inch airlift which emptied into an on-board sluice, thereby insuring maximum recovery from each square. Level Two recovery was also done by hand, or by using light lifting gear as circumstances dictated. Level One recovery was accomplished using the winch and boom aboard *Vast*.

All evolutions not directly supervised by the archaeologist underwater could be observed via an on-board television monitoring system. This consisted of a held Sony CCD (charge-coupled device) camera in an underwater housing which could be mounted so as to observe the divers' work area. The system uses an 8mm monochrome lens with light-gathering capability, and actually affords the monitoring party better underwater visibility than the diver has. Consequently, the individual observing the diver was in a position to assist as well as watch the underwater operation.

Methods

A number of methods of excavation, including propwash deflection, had been used on the site prior to the 1986 season. Additional methods were considered before and during 1986 as possibilities for the primary means of sand removal, prior to the decision to continue with propwash deflection for that purpose. Large sand dredges were eliminated as having too great a potential for destruction and offered little control over the depth of excavation. Cofferdamming had been attempted on a small scale during the 1984 season and had proven unsuccessful. Cofferdamming the entire site would have been prohibitively expensive and of doubtful value. Airlifting and/or water induction dredging on a scale that could be handled by the available surface equipment was proven to be grossly ineffective as a means of major sand removal.

Given the environmental and logistical restraints imposed on the operation, propwash deflection turned out to be the only feasible means of penetrating the sand layer to conduct any testing of the site. It was the only controllable means of removing large amounts of overburden and had the advantage of being easily integrated into the excavation sequence.

Likewise, the use of a 4-inch water induction dredge for secondary overburden removal had not been considered prior to the 1986 season. This was to prove an important part of the excavation sequence. Hand recovery, the principle means of Level Three recovery in recent years, was retained, and the use of a light airlift and sluice system was instituted as part of the Level Three recovery process.

Excavation Procedures

The procedure that developed during the testing phase as being the most efficient excavation method was a combination of several techniques. Essential to this system was the ability of the divers to communicate with the surface, which was accomplished by using an AGA Divator surface supplied system with full facemask and communications capability. This system could also be used with scuba. The recovery vessel was maintained in position on a three-point moor which allowed for adjustment to compensate for shifts in position resulting from changes in wind direction and velocity, and from changes in current.

With the vessel in position over the site, a corner stake was driven to mark the location of one corner of the test pit and the propwash deflection devices used to remove the upper layers of overlying sand. Depth above the artifact layer was controlled by divers sounding the bottom with steel probes.

Once a point ca. 2 feet above the artifact layer had been reached, the other corner stakes were driven and the 8 x 16 foot grids set in place and anchored to them. The four-inch water induction dredge was then used to remove the remaining overburden. This afforded very close control of sand removal within the grid limits and had the added advantage of being useful in reducing sloughing of sand from the berm built up by the propwash. It was far more easily managed than an airlift of comparable size.

As the grid was cleared, mapping of Level One and Level Two material was conducted, and these items tagged and removed from the grid. Level Three material was then recovered by hand, and placed in pre-numbered plastic bags according to its provenience within the grid. The bagging of material took place at the square from which they were recovered. Each 1 x 1 foot square was then cleaned off using the 2-inch airlift, and the material run through an on-board sluice similar to a gold sluice. In this manner, even the tiniest items, pins, shot, and gold dust, too small to be recovered by hand or invisible to the diver's eye, could be retrieved. However, because of the difficulty and expenditure of time involved in cleaning the sluice, provenience on this material was expanded to 4 feet x 4 feet.

Once on board the recovery vessel, retrieved items were sorted and separated according to material type. After preliminary rinsing in clean sea water, all were stored by wrapping in burlap and submerging in buckets of sea water. Items too large for storage in this manner were wrapped in wet burlap and kept wet by continual soaking with sea water. Such items could not be offloaded except at a dock facility and consequently were not brought aboard *Vast* until just prior to a scheduled return to port.

Field inventory consisted of the date, field number, provenience, a description of the material and the excavator's name. These sheets were maintained on board the recovery vessel and accompanied the artifacts to the conservation facility ashore. Except in instances when hostile environmental conditions constituted a danger to the physical safety of the artifacts, transport to the laboratory was accomplished on a daily basis. On arrival at the conservation facility, all material was stored submerged until the commencement of preservation procedures.

James R. Reedy, Jr.
MEI Laboratory
P.O. Box 1174
S. Chatham, MA 02659

LOUISE M. DECESARE

Techniques for Documenting Artifact Distribution in Concretions from the *Whydah* Site

Introduction

It was a dark and stormy night. Off the coast of Cape Cod on April 16, 1717, the pirate ship *Whydah* ran aground. Her secrets, her treasures, Captain Bellamy and his crew were scattered and silenced by a turbulent sea.

Only one voice broke that silence. Of the two known surviving pirates, Tom Davis was apprehended, leaving this skeletal account: "The Ship being at anchor, they cut their cables and ran ashore in a quarter of an hour the Ship struck, the Main mast was carried by the board, and in the morning she was beat to pieces. About sixteen prisoners drowned...and one hundred forty four in all. The riches on board were laid together in heap" (Court transcripts 1718).

Underwater there is no mound, no heap of riches. The spoils of the ship—her merchant cargo, weapons and treasure along with her provisions—churned in a bed of fine mobile sand. It is presumed that massive objects, such as cannon, would have shifted very little from their original point of impact. Smaller and lighter artifacts however, like glass, coin, textile, wood, or rope, would likely have travelled further and for a longer period of time.

Iron objects exposed to the sea water probably began to undergo electrolysis fairly quickly. During this chemical process, ions were emitted from the iron and caused nearby sand, shell, cobble and artifacts to conglomerate in iron concretions.

These concretions and the loose scatter from the wreck together compose the "*Whydah* site." We may never know all the *Whydah's* secrets. The iron objects are degrading. But within their concretions some clues are preserved. With science we can unravel nature's paradoxical "preservation" process. Patient cataloguing of these clues may eventually yield some insights into the mundane realities of pirate life and the larger cultural and economic implications of piracy.

Pirates and stormy nights are the stuff of adventure and romance. My paper will focus on more prosaic concerns—the methodical documenting of artifact distribution within iron concretions. In the varied applications these techniques offer to the archaeological process on the "*Whydah* site" science confounds adventure. The process of recovery becomes the slow climb of discovery.

When the concretions arrives at Maritime's Conservation Lab, they have been tagged as archaeological features. The identification label specifies each concretion by the year of excavation, test pit, and a unique arbitrary letter. This information is entered into the artifact catalogue along with descriptive details and the coordinates of its underwater locus.

Concretions vary greatly in size and shape. A concreted cannon will present special handling problems because of its weight and size. Consequently, separating them by size into Level 1—large and heavy—and Level 2—smaller and more portable—is necessary both for excavation and storage

Since chlorides must be leached out of the concretions in order to preserve the artifacts, they must be stored submerged in water throughout the reduction process. Storage vessels range from small tupperware containers to pool-sized fiberglass tanks.

Mechanical reduction of concretions is essentially an excavation process. As such it must be documented. Recording the artifacts which are dislodged from the concreted matrix with small chisels, hammers, punches and dental probes is relatively easy. But because the concretions themselves are three dimensional objects, reduction continually changes their shape. How then does one go about documenting concretion? There is on simple answer to this question.

Documentation techniques: X-Rays

Physical features such as size, complexity, types of artifacts and the fragility of the material vary considerably. Costly and time-consuming documentary procedures like x-rays simply cannot be applied in every instance. While in one sense this would be desirable, physical difficulties such as maintaining large cannon concretions in water baths while transporting them great distances necessitate selectivity. But which concretions should be x-rayed and on what basis?

If the concretion is complex, unique or appears to be particularly fragile, x-rays will be taken. The purpose of the x-ray is to determine, when possible, the kinds of material within the concretion. Knowing the spatial relationships between materials prior to excavation aids in establishing procedures for reduction. In the case of the bag of gun parts, F85-2A, x-rays were essential. We were able to tell that we were dealing with a very complex, and fragile concretion, but without the x-ray would not have known that we had a bag containing related parts.

Looking at the medical x-rays of F85-2A, only a few artifacts along the outer surface are discernable. It is clear, however, that there is a very dense area in the center. This indicates a mass of material.

Another x-ray taken with a commercial machine shows greater penetration. We can see distinct artifacts and also the extreme complexity of the concretion. The x-ray was used to locate placement for pins during electrolytic reduction, to act as a visual guide during mechanical reduction, and as a reference for graphic representation.

In another example F86-EC we noticed some pieces of indigo on the outside of the concretion. That some structure or container might lie within the concreted mass was therefore plausible. This feature was x-rayed and proved to be a simpler concretion. We can clearly see the presence of lead shot and an iron hook of some sort.

When we x-rayed F85-A-G, we took exposures at 45 angles to ascertain whether the angle of exposure would alter the visibility of artifacts. This was indeed confirmed and by rotating the axis, we were able to identify more artifacts.

Documentation Techniques: Latex Molds

Latex molds record the presence of totally or partially degraded artifacts. Where there are crevices, the mold will form a positive cast of the degraded iron. They are then entered into the artifact catalogue as extant artifacts. Molds aid object identification, and surface molds are useful in specifying spatial orientation. They pick up detail which might otherwise go unnoticed.

As concretion cavities emerge molds are made. The opening is first cleaned, flushing it with water and using dental probes to remove degraded remants of the artifact. When fully cleansed, latex molding compound is injected or poured into the cavity. Modeling clay forms a dam around the concretion enabling the mold to set. After approximately fifteen minutes, it can be submerged into its water bath. When the latex is removed, it forms a positive cast of the artifact.

Since conglomerates of artifacts are not necessarily an assemblage, molds aid in determining if the spaces and substance within the concretion are in fact composite artifacts. Remnants of a sword were found when excavating F86-3C, a concreted cannon. It wasn't until the concretion was substantially reduced that we could see that our latex cast was part of a larger more complicated artifact.

What had looked like a metal hook or ring of some kind, was clearly a sword hilt. The impression of the blade could be seen in a portion of the mold. And the wooden handle was associated with this piece. We have both the dimensions and the shape of an artifact which was largely absent. Not only does this aid in identification, it also makes facsimile reconstruction possible.

Documentation Techniques: Photography

The first photographs are taken to locate intact concretions on the underwater provenience grid system. This involves shooting the concretion with an artificial grid placed over it, thereby marking the provenience units. This aids in maintaining artifact provenience as we excavate. But photographs have many other uses.

They are artifact documents themselves, highlighting in black and white attributes such as texture, shape, composition and in color dramatic difference in material. They are a conservation tool-describing the physical state or condition of the artifacts. And they provide a map, a basis for guiding reconstruction.

We found it advantageous to rotate the concretions as they were x-rayed. Similarly when documenting the outside concretion surface as it changes shape, a photo record is kept. These photos will be the only objective reference remaining once excavation is completed. Hence during excavation and afterward, they are the foundation for a mapping system of drawings and illustrations.

Documenting Techniques: Mapping

Before reduction begins, a base map is drawn of the concretion in relation to its underwater grid location. This is done using the underwater field maps as a guide. As previously mentioned, the concretion is photographed with black and white film through a grid as the initial document. Large concreted objects are drawn to scale, and overlapping photographs are taken and pieced together.

Smaller Level 2 concretions can be mapped on a 1:1 scale with acetate overlays illustrating stages in reduction on the base map. We begin by taking measurements of the concretion—object size and spatial relations. As reduction proceeds maintaining accurate measurements of artifact placement is difficult. The shape and size of the concretion changes three dimensionally. But using 1:1 acetate drawings, an accessible visual synopsis of the process is kept. As artifacts are removed from concretions, they are mapped in on the acetate overlaps. Their placement, condition—i.e., broken damaged, degraded—and the individual catalogue numbers are noted. This visual document links any particular artifact with its spatial orientation both within the concretion and in the larger "*Whydah* site".

Conclusion

Together x-rays, latex molds, photographs and drawings represent critically important documentary records of concretion excavation. Not only are they visual aids for identification, but they are vital in establishing a diagnosis for excavation procedures and the conservation process. They broaden the overall picture providing information about missing or degraded artifacts. Without these techniques fragile and not readily visible artifacts might be overlooked. Finally, they provide a record of artifact distribution which is vital to interpretation.

What secrets can these techniques of documentation reveal? A painstaking catalogue of objects and their provenience sets the scene for spatial analysis. Once we understand the physics and chemistry of site formation, we can better understand and predict artifact distribution. This paradigm will aid the excavation process and perhaps future similar excavations. It will also help us differentiate organizational distribution patterns from strictly physical and chemical ones. What we may interpret beyond this is still unclear, but our discoveries on the "*Whydah* site" may yet challenge romantic popular notions about these eighteenth-century sailors of fortune.

REFERENCES

COURT TRANSCRIPTS

1718 *The Trials of Persons Indicted or Piracy, Boston.* American Imprint Series
American Antiquarian Society, Worchester, MA.

LOUISE DECESARE
MARITIME EXPLORATIONS, INC.
P.O. BOX 1174
S. CHATHAM, MA 02659

ROBERT McCLUNG

Supporting Archaeological Research in the Real World

The lean nature of archaeological projects calls for creative and innovative management of operations. We have found that our project is no different from other underwater wreck projects. The exploratory costs alone, although ultimately rewarding, were very costly. Costs for the search exceeded three quarters of a million dollars.

Our permit area is two square miles. During the course of surveying the entire area, we discovered seven other shipwrecks before finding The *Whydah*.

Our use of electronic sensing devices ranged from side-scan sonar, to sub-bottom profiling to magnetometer surveying. The later proved to be the most effective. We used a mini-ranger system to layout our grids which provided us with one meter accuracy in our survey. We then used an on-board computer system integrated with our magnetometer to record and plot the gamma readings of the wreck pattern.

Even after discovering what we believed was The *Whydah* site, producing coins and cannons and other artifacts, proving the site's identity was a dilemma. Though there certainly was a very strong indication that this was The *Whydah*, strong enough to get many investors excited, the State Board required more exacting proof. This lessened the enthusiasm when investors heard that the State Board had not confirmed the identity of the wreck.

Had the ship's bell from The *Whydah* not been found, a difficult situation of maintaining investor interest and support would have continued. The bell as well as other diagnostic material such as coins, cannons, etc., did determine the site's identity as The *Whydah*.

A research and test excavation design plan was then requested by the State of Massachusetts, Board of Underwater Archaeological Resources (BUAR). This plan was submitted and accepted. We weren't allowed to implement the plan until the next season.

Then, an unforeseen obstacle in the plan held us up for four months of the following season. Our plan called for removing the ten foot sand layer covering the artifact strata layer by prop washing. The difficulty was in eliminating or at least abating, "sand sluffing" - the cave in of the walls of the pit covering the grid area. The walls are created by prop washing.

To accomplish this we designed a "cofferdam". Using this particular dam for our design became an obstacle that severely impacted our time and cost effectiveness. During the four months that our permit was held up, the Army Corp of Engineers evaluated the environmental impact and use of our design. They worked in conjunction with the following agencies: Massachusetts Historical Commission; Welfleet Conservation Commission; DEQE; Division of Marine Fisheries; and The Cape Cod National Seashore.

At the end of this period we proceeded with our plan and use of the cofferdam. But once in use, we found it limited - it was cumbersome and at times, ineffective. We then increased our airlifting and venturi dredging to compensate for the sand sluffing. Because of this, we learned the importance of flexibility, and not getting locked into any one procedure.

Once the research and test excavation revealed the size of the wreck site, we determined that we would require additional manpower, boats, and equipment. We then submitted a plan for using a larger boat.

General Operations and Management

General operations and management is briefly discussed here in order to show the overall considerations involved in the project.

Permit and operational problems weren't, and still aren't, the only difficulties in an operation of this size. We had to reevaluate our staff several times, from archaeologists to consultants, resulting in changes in staff positions. In doing so, we realize it is time and money well spent to find and hire the most experienced and qualified personnel.

To achieve a smooth-running operation of this size takes an enormous amount of time, energy, manpower, equipment, as well as the necessity to schedule around bad weather, equipment breakdowns, etc. Repairing and replacing equipment is an on-going task as well as scheduling crew for work assignments during bad weather to maximize their time.

Transporting of artifacts and treasures takes careful planning and scheduling of boats, vehicles, and state police security detail. Mistakes made in this area would be costly and threaten the project's credibility if anything from the wreck be damaged, lost or stolen.

Finding a bank to secure the treasure can be difficult. Also, finding or building a laboratory to secure artifacts and treasure is costly and difficult because of toxic waste by-products produced by conservation methods, and the security measures which must be taken.

The overall security of the project is as important to the project as the archaeology. It encompasses good hiring practices, alarm systems, and strict security procedures adhered to by all personnel. A project which places human life, equipment and treasure at risk in underwater dives needs excellent insurance coverage. Lloyds of London is one of the few companies that will cover such a venture.

Because this project uses a wide variety of materials and equipment, sponsorship from companies and manufacturers is a good idea. Promotional advantages can be gained through sponsorship. Some of our sponsors are: Johnson Outboard, Boston Whaler, and Viking America.

Good public relations plays a big role - it is required for the success of the project. It effects our interactions within the community and with our investors.

ROBERT MCCLUNG
MARITIME EXPLORATIONS, INC.
P.O. BOX 1174
S. CHATHAM, MA 02659

SYMPOSIUM

DANIEL W. BROWN

Preservation Through Cooperation

The effects of salt water and the salt air environment along the coast have long been recognized as the chief contributor to the corrosion of metals. The National Park Service, under provisions of a 1983 cooperative agreement with the Florida State Division of Archives, History, and Records Management, requested the Division to visit Fort Pulaski National Monument to assess the extent of damage the coastal environment has had on its artifact collection, most particularly, the large cannon tubes and exterior Fort hardware.

Fort Pulaski, "one of about two dozen" Third System brick fortifications, became a National Monument in 1924 and saw extensive rehabilitation by the Civilian Conservation Corps from 1933 to 1938. Included in the Monument's collection are ten Civil War era cannons. Many of these tubes have been exposed in varying degrees to the harsh coastal environment for well over 100 years. In inspecting these items, the Division concluded that while the National Park Service had done an adequate and even good job of maintaining these cannon and preventing exterior rust, the tubes were suffering from the long term effects of penetration by corroding salts. The Division further concluded that if this corrosion went unchecked, the artifacts could be totally destroyed within a generation.

Herbert Bump, a Conservator with Florida's Division of Archives, History, and Records Management. The Division was already treating the Park's most pressing conservation needs. But its limited resources and the substantial cost of sending large heavy artifacts out of state for treatment would jeopardize the likelihood of treating the remainder of the Park's needs by this method. The Park had a facility capable of handling a laboratory, trained conservation personnel on staff, and a maintenance capability. Furthermore, the size of the Park's collection and iron hardware in place on the Fort dictated the need for long term conservation treatment capabilities. On the other hand, the Corps of Engineers had no such facilities or personnel available locally. They also lacked the authority to establish the laboratory at the District level.

The treatment and eventual disposition of the artifacts from the CSS *Georgia* was of considerable interest to a local group, the Coastal Heritage Society. The Society which operates Old Fort Jackson, a harbor defense located on the Savannah River one mile east of the Savannah River and opposite the site of the Georgia. The Society strongly supported the development of a local treatment facility fearing that artifacts that were taken from the area may not be returned. They also expressed interest in cooperating by providing volunteer personal services and a site at Old Fort Jackson for interpreting the conservation effort.

After comparing notes, the National Park Service and the Corps of Engineers realized that this "problem" was in actuality a wonderful opportunity to join forces in a project of mutual benefit. A Memorandum of Agreement was written that outlined the terms by which a conservation facility capable of treating artifacts from the CSS *Georgia* and Fort Pulaski National Monument would be operated by the National Park Service. The Corps pledged the money which would otherwise have been programmed to treat the artifacts from the CSS *Georgia* to establish the laboratory. The NPS was to construct and operate the facility. Technical assistance in setting up and operating the laboratory was provided by Florida under the previously mentioned agreement. A demonstration laboratory was established at Old Fort Jackson to interpret the preservation process to the public. The National Park Service is assisted in the maintenance and operation of that facility by the staff and volunteers of Old Fort Jackson.

The laboratories have eight tanks capable of accommodating the two cannon and 86 pieces of ordinance from the CSS *Georgia* and one cannon from Fort Pulaski. Once these artifacts have been treated which will take two years or more, additional items from the Corps of Engineers or the National Park Service can be treated. Under the terms of the agreement once the initial treatment is completed, the Corps of Engineers reserves the right to use four of the tanks for treating their artifacts. Services provided by the staff from Fort Pulaski are reimbursed on an actual cost basis. Should the Corps have no immediate use for the tanks it may authorize the National Park Service to use them. The remaining four tanks are for the use of the National Park Service.

The direct benefit from this arrangement is the conservation of valuable artifacts significant to the local area. Without such a facility these objects would be transported great distances at considerable cost or be left to rapidly deteriorate. The long term conservation requirements at Fort Pulaski National Monument and the likelihood of additional artifacts from the CSS *Georgia* being recovered from the Savannah River make the Metal Conservation Laboratory a very worthwhile investment.

A secondary, but in many ways equally significant benefit is the agreement by which the facility will operate. Two federal agencies have joined forces along with a state agency and a private non-project group to provide a local laboratory for the preservation of cultural resources which may otherwise have been lost. The combination of resources, capital, manpower, facilities, and technologies with a strong preservation ethic will not only advance preservation practices in this community but may lead to the development of similar agreements in other areas, This innovative approach to the treatment of artifacts is a positive advancement in the treatment of metals exposed to the salt environment.

DANIEL W. BROWN
P.O. BOX 98
TYBEE ISLAND, GEORGIA

DAVID A. MUNCHER

Preliminary Analysis and Conservation of the *Widgeon* 1864-1867

Introduction

Florida's geographical borders include over 2000 miles of coastline, second only to Alaska in total length among the 50 states. In addition, there are hundreds of miles of navigable rivers, inland waterways, canals, and lakes. Florida was also the first contact point of the North American continental landmass encountered by European explorers in the 16th century. A long maritime history, combined with an extensive coastline, has resulted in Florida waters containing the largest number of shipwrecks of any state in the United States.

Florida is visited annually by several million divers, snorklers and beach combing tourists. The task of actively managing wreck sites is not unlike that faced by patrollers along the Mexican-American border; there is too much area and too few resources are available. The State of Florida's Bureau of Archaeological Research has the responsibility of managing the nearly 1500 known wreck sites in state waters. Determining the significance of even a small proportion of these sites requires money and manpower beyond the Bureau's present resources.

As one step to begin to resolve this problem, the Bureau has begun a pilot program which allows qualified individuals to salvage certain types of shipwrecks working in conjunction with state archaeologists and under contract agreement with the Division of Historical Resources. Generally, sites which are favorably considered are those which are relatively modern and which do not have overriding historical significance. Excavations are monitored by archaeologists from the Bureau and technical assistance is provided as needed. In return, artifacts, field notes, and documentation obtained from the work are received by the Bureau for analysis and publication.

The program produces several positive results. First, it allows avocational divers to conduct and participate in an archaeological excavation under supervision of state archaeologists. This allows sites to be investigated and documented to which the Bureau could not realistically devote its limited resources. Additionally, through close supervision, disturbance of the site is kept to a minimum. And finally, it is hoped that in the future more sites will be reported if divers know there is a willingness on the part of state officials to work with them.

The Site

The shipwreck is located on a large industrial occupation site known as the Brickyard which encompasses several acres of land and water along the St. Mary's river (Figure. 1). A large clearing at the river's edge coincides with the present boat ramp, and an old wooden dock, and several earlier dock remains. The clearing is surrounded by numerous middens of construction and cargo rubble consisting of stone and brick. In addition to the modern road which leads to the clearing, an earlier roadbed can still be discerned, although it is now heavily vegetated.

During the site survey, a series of docks or landings was found along the river's edge adjacent to the Brickyard. The landings were not disturbed; however, it was observed that each structure in the series is in a progressively worsening state of decay. The two earliest docks are located several dozen yards downriver from the extant wooden landing, and are covered with several feet of overburden. In each case it is apparent that the more recent dock or landing was built upriver from the previous one. The last and most modern landing is a concrete boat ramp presently in use. No other landings could be located in the heavy underbrush upriver from the concrete ramp, although several rather large and distraught cottonmouths were.

The vessels focsle rests about 3 meters from, and parallel to, the most recent of the wooden docks at a depth of from .5 to 1.5 meters depending on the tide. The hull lists at about 50 degrees to starboard; the aft end being slightly farther into the river channel and about 3 to 4 meters deep. The starboard frames and hull strakes have collapsed outward and down, and lay scattered beneath river debris which has accumulated. Artifacts and hull debris are concentrated within a 15 meter radius extending outward from the aft starboard quarter. This is not surprising since the river flows toward the aft and the starboard side leans downslope.

Conservation of the Materials

Approximately 2800 artifacts were recovered from the site posing a broad spectrum of conservation problems. This is true of most shipwreck sites, which frequently yield diverse artifactual assemblages such as ceramics, wood, and metals. Artifacts were divided into three major categories according to conservation requirements.

Ceramics and glass composed the largest group of material scattered over the wreck. No treatment was required other than individually washing each piece with a soft nylon bristle brush and warm water. Each ceramic sherd was then closely inspected for marks or inscriptions.

Visual inspection of ceramic sherds revealed several facts. Ironstone sherds from plates, cups, and bowls were similar enough to suggest that the items originally constituted a matched set. Several pieces bore the makers stamp, 'John Maddock, Burslem' (England) on the bottom indicating European origin. Maddock's Newcastle Street Pottery Co. in the Staffordshire district produced ironstone china from 1842 until the present (Boger, 1971). One sherd was stamped J23 E/O, a possible serial number, and five sherds were found to have portions of the word *'Widgeon'* calligraphically printed beneath the glaze. This implies a pre-ordered set of ship's crockery which was customized at the time of manufacture in England, or, the material could have been glazed after being purchased in America.

Wrought iron fasteners and ship's fittings made up the second largest category of artifacts recovered. After sand and mud are removed by washing, all iron materials will be placed in the hydrogen reduction kiln and heated to +800 degrees Fahrenheit in a hydrogen atmosphere for four days. This will be followed by electrolytic reduction for fourteen days to remove any remaining chlorides in the metal lattice. Several types of brass fasteners including cut nails and wood screws were also recovered.

Numerous pieces of melted lead and portions of 3 inch diameter lead pipe were recovered throughout the site. Lead pipe was common on ships of this type and was probably part of a low pressure gravity drain system.

Natural tannins present in the river preserved most brass and copper artifacts; only a minor stain of sulfide was present and no evidence of bronze disease. Brass and copper items were placed in electrolysis using 5% sodium bicarbonate for an average of three days to mechanically loosen mud and debris. This was followed by

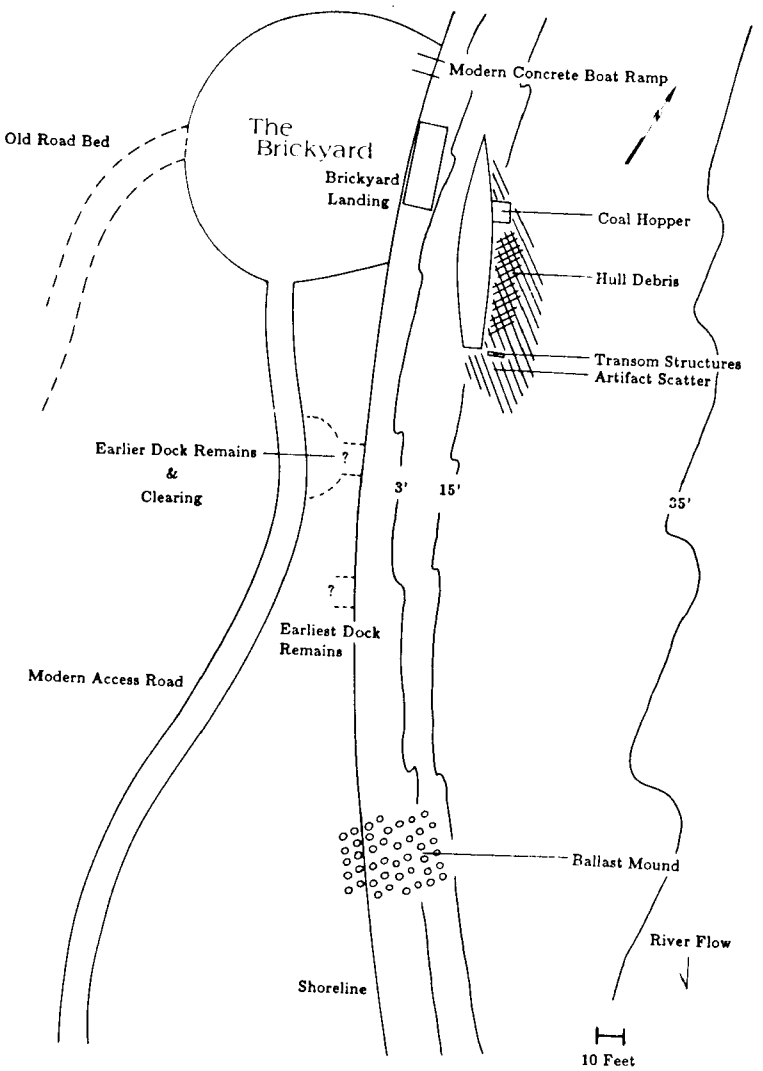


FIGURE 1. The Brickyard Site

a final coat of Incralac to inhibit further degradation. This appears to be an adequate treatment for cuprous metals having a low chloride, high tannic acid content.

A spring loaded brass pressure relief valve complete with leather washers and engraved 'W.S. Carr, Patd. August 5 1856' was cleaned in electrolysis and restored to a working state. The heavy internal spring had evidently been annealed at the time of the fire losing rigidity and tension. Manual brass bibb and stopcock type valves were equally well preserved and bore the engraving 'HAYDEN & SANDERS' (Association for Preservation Technology, 1980). The bibb valve showed signs of having been silver brazed into some form of seat or tube.

Copper tubing of 1/2 inch diameter was formed by rolling long narrow sheets of copper into an overlapping tube. The tube seam was then sealed with silver solder. On the pieces found, most of the solder had melted away leaving an overlapping open seam along the length of the tubing. Much of the tubing exhibited violent tearing on the ends which occurred either at the time of the accident, or more probably during salvage of the engine afterwards.

A heavily tarnished brass decanter top bore the inscription, 'PATENT APR. 2?186?. The top was tightened to the decanter by pushing it down onto two opposing stubs on the decanter rim, then quarter turning the top. Although the decanter was not found, it was likely also of brass.

The Hull

Several factors worked synergistically to produce a high degree of preservation of the vessel's remains. First, water in the St. Mary's River has a high concentration of natural tannins in solution, a preservative for wood and iron. An added benefit of the tannin is reduction of light penetration to approximately one foot, which in conjunction with the relatively cold water, effectively limits growth of algae and other plant life detrimental to the wreck.

The newness of the vessel itself at the time of sinking greatly enhanced the overall survival of timbers and fasteners. Approximately 70% of the hull timbers below the waterline are extant in their original configuration, and, although buried at present, it appears that the entire keel and garboard assembles are intact (Figure. 2).

Design and construction of the vessel is characteristic of 19th century steam driven craft in use along inland waterways. The ship had a shallow draught, five to six feet, and a soft chined hull. It is speculated by the author that it had a flat keel, although this remains unproven because of the large amount of mud which would have to be moved to confirm this. Both the stem and stem posts were nearly perpendicular to the keelson, the stem being slightly raked forward. Length between uprights was approximately 60 feet and deadwood still present indicates there was a counter and round ended stern assembly. This would give a probable length on deck of 55-65 feet, and an overall length of around 75-85 feet.

The vessel was burned to the top of the bilge turn eliminating any evidence of wales; however the widest remaining portion of the beam is 15'6", an approximate ratio of 1:5. The keelson is 95% complete and has a length of 54 feet, is moulded 8 inches, and sided 6.5 inches. The keelson begins just aft of stem deadwood and runs continuous into the stern propeller shaft deadwood. Bilge stringers have a length of 24.3 feet, moulded 5 inches, sided 7 inches, and spaced about 20-21 inches from the keelson along their entire length.

Frames are compound, sided 4 inches, moulded 8 inches, and spaced 15-16 inches, with limber holes through most floor timbers. Each frame was constructed of a floor piece bolted to the keel. Frame futtocks were then bolted to the floor pieces, side to side, rather than by scarfing the ends. Ceiling planks are moulded 3/4 inch, sided 8 inches, and butt joined over frames. The carvel hull strakes are butt joined without scarfs, moulded an average 2 inches, and sided 5 inches. Animal hair soaked in pitch and 1/32 inch copper sheathing was fastened with 2 inch brass tacks over the entire hull below the waterline.

Sheathing was folded back on itself at the edges and adjoining sheets were partially overlapped. The remaining bottom sheet was folded back over the adjoining sheets edge, then nailed to form a complete seal. Sheathing tacks were individually caulked by driving the tack through a dab of pitch placed on the seam. A square tack pattern was used throughout in fastening hull sheathing.

Construction of the propeller shaft well is complex and clearly reveals the precise sequence of construction. After the keel and rear frames were in place, a single, long block of wood was butted against the inside of the sternpost and fastened in place. The wood was cut V shaped on the bottom to conform with the frames and hull planks; the upper portion was cut with a groove conforming to the outside diameter of the propeller shaft guide. Probably, a layer of caulking was laid, then the shaft guide was passed through the sternpost and placed in the caulked groove. More caulking was laid on top of the guide, then another single, long block of wood cut to conform to the guide was put in place. Finally, another single massive block of deadwood was bolted over the entire assembly tightly butted against the inner sternpost. The propeller shaft itself was then fed through the guideway.

Identification of the Wreck

Initially the wreck was erroneously identified as the *Martha*, a passenger steamboat operating on the St. Mary's river in the 1880's (Tower, 1986). This hypothesis proved to be unworkable for several reasons. Reconstructive line drawings produced by the Laboratory staff showed a hull configuration of much greater dimensions than originally believed. Sketches made by the salvors reflected an

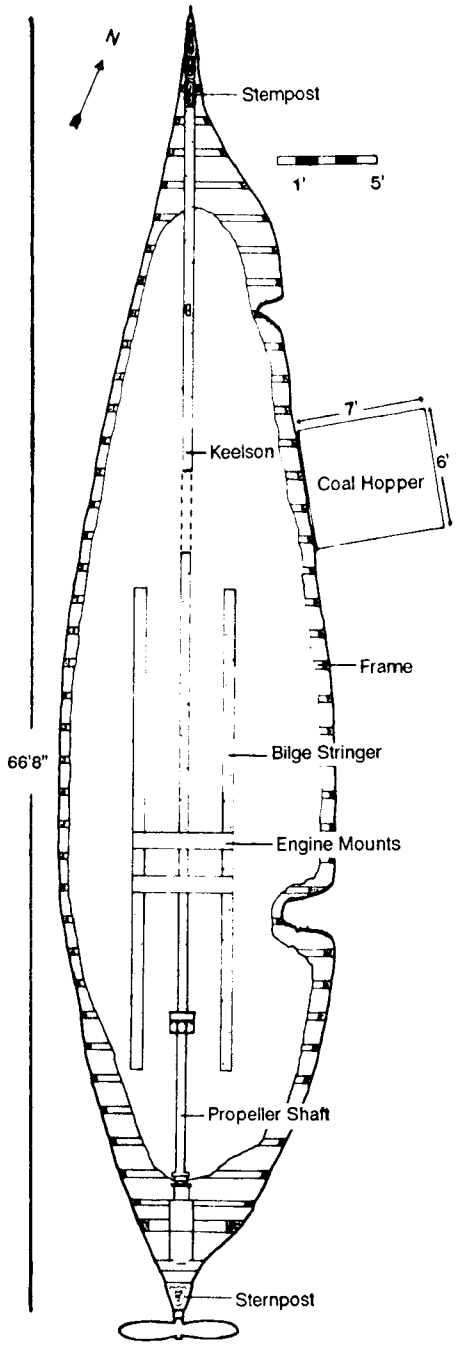


FIGURE 2. Top view of the hull remains

overall vessel length of 65 feet from sternspar to the propeller tip, failing to include the upper round ended stern assembly common to boats of this type. Proper estimation of overall length revealed a vessel of 75 to 85 feet, a size too great for the *Martha*. This minor error caused attention to be diverted to smaller vessels, and the vessel to remain misidentified for several months.

In February 1986, preliminary laboratory evaluation of the site began at the Florida Research and Conservation Laboratory. Wreck remains were inspected by a conservator archaeologist to verify accuracy of data recovered by the salvors. This was followed by close inspection of ceramics removed from the site revealing several makers marks, serial numbers, and portions of the word *'Widgeon'* printed on five sherds. The vessel's identity was confirmed by consulting the Lytle/Holdcamper list (Mitchell, 1975).

Lytle/Holdcramper lists the *Widgeon* (reg. 26275) as a screw driven steamboat of 56 tons which burned on April 8 of 1867, at Jacksonville, Florida with an unknown loss of life. Built and first homeported at Ogdensburg, New York during 1864, the vessel was only two and one half years old when it burned and sank.

Analysis

The *Widgeon* lies about 2.5 meters out from, and parallel to, a dock landing. The dock itself predates the first decade of this century, as attested to by an early photograph of the site. The Widgeon's close proximity to the dock suggests a scenario in which the vessel was moored and off-loaded at the time of sinking. Ceramics and glass are all typical of items which normally would be present and are probably not indicative of any cargo which may have been aboard.

Ceiling planks are severely scorched on the inside, throughout the length of the vessel. By contrast, the hull strakes are relatively unburned on both inner and outer surfaces, and it is likely that the high temperatures from the blaze produced caulking failure, which was the final blow to the *Widgeon*s watertight integrity. The vessel came to rest on its starboard side on the shallow, strongly sloped bottom adjacent to the dock. Resting on a 55-65 degree angle, the port side would have protruded out of the water, while the starboard side of the ship was entirely submerged.

Shortly after the sinking, the propulsion system was salvaged. It is clear that the engine was removed after sinking, for two reasons. As mentioned above, all inner ceiling planks were burned, with the exception of the area immediately below the two transverse engine mounting beams, which exhibits little evidence of burning. Another indication of the engine's salvage is the condition of the hull itself. The starboard side appears to be much more intact than the port side, and portion of it have collapsed and fallen downslope from the vessel. Most of the separated debris consisted of hull strakes lying beneath, and still attached to upper frame futtocks. The edge of the remaining starboard hull is more complete and less abraded than the port side. No debris from the port side could be found around or in the hull. A probable explanation would be the salvagers, to facilitate removal of the engines from the shore, simply destroyed most of the protruding port side and left the inner starboard side to walk on while working.

Historically, steam vessels ran on low pressure (2-20psi) systems until the 1860s when higher pressure (40-60psi) compound engines were being installed. Compound marine engines were subsequently replaced by triple expansion engines in the 1870's. *Widgeon* was built during this transitional period and faulty technology may have been responsible for the loss. *Widgeon* was consumed rapidly by an intense fire, since melted brass valves and copper tubing attest to temperatures in excess of 1900 degrees Fahrenheit. The presence of utensils, tools, ceramics, and machinery on board demonstrate an accidental burning, and the close proximity to a dock landing suggests that the vessel was moored at the time of the sinking. No evidence is present to firmly prove the cause of the accident; however, a boiler explosion would not be an unreasonable assumption.

Conclusion

The *Widgeon* project represents one of the first shipwreck sites in Florida in which salvors have worked in close association with State archaeologists. The significance of the *Widgeon* lies in its extensive hull remains and dateable artifactual materials recovered. The excellent quality of construction denotes an affluent New England shipbuilding industry during a period when the southern portions of the nation were devastated by the civil war.

No plans presently exist to excavate the remaining hull structures. Realistically, funds required for such a project would be extensive and the amount of additional data which could be gained does not justify such an expenditure. It is likely that the vessel's remote location, in combination with the low visibility and high tannic acid content of the St. Mary's river, will insure survival of the site should future interest in the site increase.

An interesting question relating to the site deals with the massive dock timbers directly adjacent to the hull. The *Widgeon* sank in a position which entirely blocks access to the dock. Common sense dictates that the major dock landing of that area and time period would not have been constructed 3 meters from a large sunken vessel. Therefore the dock must have been constructed prior to the 1867 sinking of the *Widgeon*. An intact dock dated prior to 1867 is of major interest in itself and is deserving of further attention.

The Bureau of Archaeological Research maintains an extensive collection of shipwreck artifacts recovered from sites as early as the mid-16th century, and extending temporally into the 1800's. The *Widgeon* site represents the most complete collection of shipwreck artifacts of the Civil War period acquired by the State of Florida to date. With the addition of the *Widgeon's* artifacts to the type collection currently being developed by the Bureau, the upper temporal range will be extended by 50 years

REFERENCES

ASSOCIATION FOR PRESERVATION TECHNOLOGY
1980 *Illustrated Catalogue of American Hardware of the Russell & Erwin Co.* ca. 1865. Association for Preservation Technology, USA.

BOGER, LOUISE ADE
1981 *The Dictionary of World Pottery and Porcelain.* Charles Scribner's Sons, New York.

MITCHELL, K. R. (ed)
1976 *Lytle/Holdcamper Listing of Merchant Steam Vessels in Operation from 1790-1868.* Steamboat Historical Society, Baltimore.

TOWER, H.B.
N.D. *Excavation of the Brickyard Wreck Site in the St. Mary's River: The Final Report.* Manuscript on File Florida Division of Historical Resources.Tallahassee Fl.

DAVID A. MUNCHER
RESEARCH AND CONSERVATION LABORATORY
DIVISION OF HISTORICAL RESOURCES
THE CAPITOL, TALLAHASSEE FLA. 32399

HERBERT D. BUMP
DAVID A. MUNCHER

Conservation of Historic Artifacts from Marine and Coastal Environments

Conservation is an exciting and challenging discipline concerned mainly with the stabilization and preservation of degraded archaeological and historical materials. Conservation requires knowledge and application of a wide range of scientific methods used in chemistry, physics, electrical engineering, archaeology, and of course corrosion engineering.

It would be nice if all artifacts were well cared for, but this is rarely the case. The Laboratory is often called upon to perform our special brand of magic only after an artifact has been allowed to reach sometimes severe states of decomposition. Artifacts selected for conservation may in many instances be extremely fragile or rare, thus limiting our ability to deal effectively with various types of corrosion products. Most modern materials would simply be thrown away if allowed to reach the advanced state of decay typical of such artifacts.

When conservation needs are compared to the conservation facilities available the shortcomings are striking. There are many hundreds of shipwrecks recorded off the Florida coast, and each wreck might contain more than a thousand artifacts. If a laboratory could process one artifact every hour (it takes longer, of course) it would take centuries to treat these artifacts alone. If terrestrial artifacts are added, both historical and archaeological, it becomes obvious that only the most archaeologically or politically important materials can be accepted for treatment.

To make matters worse the public has very little understanding of internal corrosion processes taking place. Sport divers innocently thinking to take home a souvenir, remove a ship's wheel, only to watch if fall to pieces within a short time. Corrosion of large artifacts occurs so slowly that the untrained eye simply does not notice the gradual deterioration over the years, until it is too late. The science of corrosion is very complex and most people who are in charge of parks or historical societies and who see artifacts on a daily basis are not trained to recognize corrosion problems.

The Research and Conservation Laboratory attempts to provide quality treatment to as many artifacts as possible. Using technologies developed by industry, other conservation facilities, and in house, the system now in use has achieved a high rate of success for artifacts processed.

The majority of our work is accomplished by electrolysis. This procedure has been known since the early 1900's and is one of the most common methods used in the stabilization of metals. It is especially effective in the treatment of metals that have been contaminated with salt by long submergence under the ocean or from exposure to the corrosive atmosphere of coastlines.

Almost anyone can set up an electrolysis system and maintain it successfully with no understanding of the chemistry involved. The basic concept is an oxidation-reduction reaction involving (a) an artifact, (b) a suitable tank to hold the artifact, (c) the electrolytic medium, (d) an anode, and (e) a DC power supply.

When the system is properly set up, the electrical current travels from the positively charged anode through the electrolytic solution to the negatively charged artifact. This breaks down the iron chlorides in the artifact, leaving the positive iron ion and the negative chloride ion. Since opposites attract, the negative chloride ion migrates from the artifact and through the electrolyte, to the positive anode. The positive iron ion remains with the negatively charged artifact. In simple terms, this process removes the chlorides from the artifact and maintains the artifact surface intact.

Another procedure which has been in use for some time is hydrogen reduction. The Lab designed its present hydrogen reduction system from equipment already available in the laboratory. By adapting a pottery kiln and fabricating a retort the system was relatively inexpensive to build. The design was combination of the hydrogen bright anneal heattreat furnaces used in the aerospace industry and the spheriodition heattreat furnaces of the munitions industry.

The kiln allows the system to be slowly brought up to working temperature over a period of several days, to be maintained at 650 degrees centigrade for several days, and then slowly cooled to room temperature. The retort within the kiln is sealed allowing precision control of the gas mixture to maintain an oxygen free chamber.

The chemical reaction depends on superheated diatomic hydrogen. Hydrogen is the smallest atom. Because of its small size, hydrogen penetrates iron easily, allowing reduction of most corrosion products back to their original states. For example, iron chloride is reduced to iron and the chloride ion unites through hydrogen bonding with hydrogen and is purged as hydrochloric acid through the exhaust system. The major drawback of hydrogen reduction is that diatomic hydrogen is very explosive and extreme caution must be taken when using such a system. The main advantage of hydrogen reduction is its short duration; artifacts that would normally require up to one year to process in electrolysis, can be treated by hydrogen reduction in 14 days. Put simply, it accomplishes what electrolysis does in a fraction of the time.

Electrolysis and hydrogen reduction are both economical and satisfactory systems for processing large numbers of artifacts. Their success warrants continued use in laboratory settings. But one of the greatest challenges conservators face is how to treat large artifacts in the field, those which may be too fragile to move, or are simply too massive. Often transportation to and from the laboratory is more difficult than the actual stabilization. The Lab has experimented with and implemented several new techniques for field treatment of artifacts.

In private industry, one of the standard methods for corrosion prevention is protective impressed DC current. This is a simple concept electrochemically, and involves making the structure to be protected the cathodic portion of a DC closed circuit. Cathodic protection systems can be found almost anywhere that large metallic structures exist. These include commercial and military ships, major bridges around the world, and most major oil and gas pipelines.

But in the world of archaeological artifact preservation, in situ protective systems are virtually non-existent. Because of the limited funding of the sciences in comparison to the readily available resources of private industry, structures which are unique and historically significant are being lost. Among these can be listed coastal historic military installations, early industrial machinery of many types, the U.S.S. Monitor, and even the U.S.S. Arizona on the bottom of Pearl Harbor. These national treasures are being allowed to slowly disintegrate.

Under the waters of John Pennekamp State Park in the Florida Keys lies a mock shipwreck reconstructed for the enjoyment of sport divers. What is unique about this site is that a sacrificial anode system has been incorporated into the display which continually 'treats' the cannons and metal objects as they lie upon the ocean floor. This

system could easily be adapted to most metal artifacts underwater which deserve protection from corrosion. It is relatively cheap to install and can stop further disintegration of metal objects. This system, if utilized on valuable sites, may over several decades mean the difference between still having the site or losing it to rust.

Another new method developed for use on large immobile artifacts is what has been dubbed 'dry electrolysis'. Because of the successful use of electrolysis in tanks it was decided to take the procedure one step further. The conductive coatings and current distribution ratios were already well known in private industry, and applying them to artifact conservation posed few problems once the idea was conceived. The only real problem was simply finding the proper electrolyte and the best way of affixing it to the artifact surface.

The laboratory is experimenting with several types of electrolyte in felt cloth which is attached to the surface of the artifact. The felt is then covered with a thick layer of conductive anode coating, forming an electrolytic 'sandwich'. A .031" platinum coated anode wire is embedded in the coating of conductive mastic in order to achieve the proper amperage and current distribution. The average electrolysis system with a 2% sodium hydroxide electrolyte operates at approximately 50 milliamperes per square foot. The average impressed current system on a bridge is approximately 3 milliamperes per square foot. The dry electrolysis method works well within these limits.

We are pleased with initial results of these experiments. The future application to large metal artifacts will solve our toughest logistical problems, reduce the number of man hours in the field, reduce the amount of electrolytic equipment needed to preserve many large artifacts and make it possible to preserve many large artifacts that could otherwise not be treated.

Recently, the Laboratory has begun to address the problem or mass treatment of organic materials. Florida has more than its share of aboriginal indian canoes with little or no treatment being given to these artifacts. Using procedures developed at Texas A&M and modified by the Laboratory staff, a sucrose treatment tank which is 24' x 4' x 4' has been constructed. After completion, the tank was filled with 12,000 pounds of partially refined sugar, and an antibacterial agent. The system is intended to treat as many as six cypress canoes at a time, and a variety of smaller wooden artifacts. More than two years of background research was conducted before the decision was made to invest in sucrose treatment, however, it is felt that sucrose will become one of the most cost effective methods available for large scale treatment. The Laboratory is now exploring the possibility of using freeze-drying techniques in conjunction with sucrose.

One final problem frequently encountered is what to do with artifacts which are too badly degraded to save. This is quite common with artifacts recovered from submerged marine sites. Many times we only have a hollow encrustation from which to extract information. It is standard procedure in the laboratory to record data on artifact log sheets. Hollow encrustations can be cut open, drawn and then recorded on such sheets as one alternative. If an artifact particularly warrants being preserved in some physical form, then casting with Hysol epoxy or polysulfide rubber will provide a three dimensional representation.

The Florida Research and Conservation Laboratory is striving to make readily available the conservation method which will best suit each artifact. Training programs are also being developed to educate both the public and staff personnel interested in the science of conservation. Archaeological artifacts are the heritage of all of us and, once lost, they can never be replaced. It would be nice if important artifacts were well cared for; we hope this will reduce the need for expensive stabilization projects in the future.

HERBERT D. BUMP
RESEARCH AND CONSERVATION LABORATORY
DIVISION OF HISTORICAL RESOURCES
THE CAPITOL, TALLAHASSEE FLA., 32399

DAVID A. MUNCHER
RESEARCH AND CONSERVATION LABORATORY
DIVISION OF HISTORICAL RESOURCES
THE CAPITOL, TALLAHASSEE FLA., 32399

JUDITH A. LOGAN
GREGORY S. YOUNG

Current Research in Wood and Leather Treatments at the Canadian Conservation Institute

Introduction

The Canadian Conservation Institute (CCI) has been engaged in the conservation of wet, organic archaeological material for a number of years. In addition, research projects are performed to study the degradation of materials, as well as to develop and evaluate the effect of conservation treatments on those materials.

This paper describes the direction of research in two areas. In waterlogged wood conservation, a method is described which is useful for determining the distribution of polyethylene glycol (PEG) in woods. This is leading conservators to a better understanding of how molecular weight of PEG and PEG distribution influence the success of treatment. In skin and leather conservation, a simple but elegant method is reported, for determining (estimating) the extent of degradation of collagen and for studying the effect of treatments on the stability of collagen. The techniques discussed rely on visual microscopy to assess condition of these materials and the effect of treatment.

PEG and Wood

Since Christensen's work in Denmark in the 1960's (Christensen 1970), PEG has become widely accepted as a treatment for waterlogged wood. Empirical results from research on PEG treatments have led to a better understanding of the influence of difference grades of PEG on the dimensional stability of wood (Grattan 1970). There remain, however a number of "unknowns" about the PEG/wood/water interaction. These have been investigated for the purpose of improving the selection of PEG grades to suit not only the condition but also the type of wood to be treated. (Young and Wainwright 1982), (Young, unpublished) (Hoffman 1982), (Watson 1982), Hoffman 1984), (Hoffman 1986).

In 1981, at the ICOM Waterlogged Wood Working group conference in Ottawa, Young and Wainwright described a staining procedure, using cobalt thiocyanate, to dye polyethylene glycol blue in order to detect it in cross-sections of treated wood (Young 1982). Better control, and therefore increased accuracy in determining the distribution of PEG in wood, was found to be possible by examining cross-sections by fluorescence microscopy rather than the bright-field method, which relies on the individual examining the samples to be able to distinguish subtle colour differences. Wood has a natural fluorescence which is quenched when stained PEG is present in the cell walls and this provides ample contrast for assessing diffusion of PEG (Hoffman 1986).

Replacement of bound water in the cell walls by PEG is particularly important for successful conservation (Hoffman 1982). Work carried out by Gratten at CCI in the early 1980's indicated that wood treated with PEG 400 has greater dimensional stability than wood treated with higher molecular weight PEG alone(Hoffman 1984). The theory was that lower molecular weight PEG could penetrate the cell wall, and bulk the cell wall capillary network. Higher molecular weight PEG did not have access to that particular structure.

Continuing on this line of work, one of us (GSY) began using fluorescence microscopy to examine wood treated with different molecular weight PEGs. Samples of Aspen treated with 30% aqueous solutions of PEG 200, 300, 400, 600, 1000, and 1450 indicated that the low molecular weight PEG's (200, 300, 400, 600) had access to the cell wall, with PEG 200 showing the greatest penetration. PEG 1000 showed considerably less penetration while PEG 1450 only bulked a small portion adjacent to the cell cavity.

When the same series of tests was conducted using 15% PEG, the evidence indicated that less PEG penetrated the cell walls. The conclusion was that concentration as well as molecular weight influences bound moisture substitution.

From this point, the work was expanded to look at various species of wood and the corresponding ability of PEG to substitute bound water. Species tested were Aspen, Red Alder, White Spruce, White Elm, Red Cedar, White Ash and White Oak. Table I summarizes the results.

Of particular interest was the observation that both White Oak and White Ash showed little or no cell wall infiltration by PEG. These two woods, particularly the oak, are known to be difficult to treat. One suggestion for further work is to look at even lower molecular weights to treat the cell walls initially, then continue to a higher molecular weight to bulk out degraded cells (Young 1986).

At the 1981 Waterlogged Wood Conference, Jacqui Watson reported successful treatment of very degraded hardwoods using a combination of PEG 400 and PEG 4000 (Jacqui Watson1982). The PEG staining has demonstrated the diffusion of low molecular weight PEG into the cell wall and had showed that at an appropriately high concentration, high molecular weights of PEG completely bulk the pores and lumens of wood. For degraded wood, a combination of high and low molecular weights would seem to be appropriate (Young 1982) (Hoffman 1986).

In our Archaeology Laboratory, all PEG treatments on wood are done at room temperature. This greatly reduces the cost of treatment and, for small artifacts, does not seem to appreciably affect treatment time. CCI is presently involved in a study of the effects of heat on the chemical stability of PEG.

Skin and Leather

In the area of research on skin and leather artifacts, we also have been working on developing processes for the characterization of skin. This encompasses several aspects including condition of the collagen, presence and nature of contaminants, effect of contaminants on collagen, effect of cleaning (with detergents and chelating agents) and the effect of lubricants such as PEG 400 and glycerol.

Most of the work has been generated by the need to develop techniques to treat frozen, untanned furs and skins from Thule sites in Canada's Arctic (Segal 1984). Since the skins for the most part had never been tanned, we did not wish to introduce any agents which might bond with the collagen in such a way that they would mask the original skin preparation techniques. Also, the skins initially appeared to be in very poor condition, extremely smelly (nauseatingly so), dirty and fragile. It was necessary to determine as accurately as possible, the true condition of the collagen. Through analysis of the contaminants, it was found that the soils associated with the sample skins contained a high proportion of calcium. High lipid content was also found.

In 1982 one of us (GSY) began investigating the application of a technique called "shrinkage temperature measurement" (Ts), to characterize the condition of the collagen in the skins (Young 1986). Shrinkage temperatures of collagen have been used in the tanning industry to determine degree of tannage in hides. This technique is a modification of the industrial process, using much smaller samples. The strands of collagen seen in skins and leathers are actually bundles of fibres. Each minute fibre is made up of a multitude of fibrils which parallel each other. In turn, these are composed of the basic

WOOD	PEG 200	400	600	1000	1450
Aspen	good	good	good	mod	poor
Red Alder	good	good	good	mod	poor
White Spruce	good	good	good	poor	poor
White Elm	mod	mod	mod	poor	poor
Red Cedar	mod	mod	poor	poor	poor
White Cedar	mod	poor	poor	poor	poor
White Ash	poor	poor	poor	poor	poor
White Oak	poor	poor	poor	poor	poor

TABLE I PEG infiltration in various species of Wood
mod = moderate

molecular building blocks of collagen, tropocollagen molecules, which cross-link through three types of chemical bonding (Bienkiewicz 1983). Deterioration can be equated to a lessening of the cross-linking, a loss of the parallel order of the fibrils and a shortening of the collagen molecules.

In order to assess the degree of deterioration, strands of collagen are immersed in water, then heated. This will cause deformation or shrinkage of the collagen bundles. The temperature at which these changes take place reflects the degree of deterioration, with degraded collagen shrinking at a lower temperature then undegraded.

The measurement of shrinkage temperature of collagen is now being applied not only to untanned, archaeological skins but also to vegetable-tanned leathers and ethnographic skin artifacts. The beauty of the test is that it is essentially non-destructive, since the sample size is tiny...only a few fibers. This allows samples to be taken from several locations on an artifact, and for the same artifact to be tested after treatment, either immediately after or at some later date. In fact, one of the potentially most important uses of Ts measurements is to monitor the long-term stability and therefore deterioration of collagenous artifacts in museum storage and display. Preliminary testing indicates that some substances commonly used in conservation treatments affect shrinkage temperature. When PEG 400 is used to lubricate the collagen bundles prior to freeze-drying, the collagen has a slightly higher Ts after treatment. Glycerol, also commonly used as a lubricant in leather treatment, lowers the Ts of collagen fibers and, therefore, possibly leaves the collagen in a swollen condition and more vulnerable to deterioration.

Use of shrinkage temperature measurement to characterize condition of collagen has recently been applied in the treatment of a document found in a cairn in the Arctic. The document, deposited by William Edward Parry during his first voyage searching for the Northwest Passage in 1819-20, was found by a geological survey crew in spring of 1984. It had been sealed in a copper cylinder, was wet and in extremely poor condition. Examination indicated that it was an untanned skin, probably either parchment or vellum, and that the writing surface was in much poorer condition than the rest of the skin. The layer supporting the writing had Ts ranges averaging 53 degrees to 58 degrees C, while the bulk of the skin had Ts ranges of 58 degrees to 62 degrees C. Untanned, undegraded mammal hides have a Ts range of about 62 degrees to 65 degrees C. Microscopic examination revealed that the collagen bundles in the top layer were oriented parallel to the plane of writing, while the collagen in the rest of the skin had a higher angle of weave. The transition between the two layers was abrupt. Crystals of calcium carbonate ($CaCO_3$) and phosphates were also detected (analyzed by x-ray diffraction). The conclusion from the examination was that the skin was untanned and had been prepared for writing by stretching then rubbing the surface with crushed $CaCO_3$ (and possibly crushed bone). Subsequent wetting resulted in swelling and deterioration of the collagen. The skin also became saturated with copper from the cannister.The analysis had a direct influence on our choice of treatment. The object was successfully dried using a suction table. This was chosen rather than freeze-drying or drying from solvents since we could predict that the top layer was going to shrink at a different rate and with different characteristics than the bottom layer, and use of the suction table ensured even pressure throughout the fabric of the skin. This facilitated bonding of the top to the bottom layer.

Final treatment of the document involved preparing a support, in this case, a free mount that allows the object to be flipped for examination of both sides. If stored at a constant relative humidity, the document should remain chemically and physically stable.

Summary

This paper has described how two recently developed techniques can be used as an aid to determine condition of artifacts, as well as the degree and effect of treatment, and are enabling us to study deterioration, devise treatments and monitor their long-term effects. Full de-

scriptions of the analytical techniques discussed will be published in the coming months in conservation journals.

REFERENCES

BIENKIEWICZ, KRYSZTOF
1983 *Physical Chemistry of Leather Making*, Robert E. Kreigh Pub. Co., Florida.

CHRISTENSEN, B. BRORSON,
1970 *The Conservation of Waterlogged Wood in the National Museum of Denmark*, National Museum of Denmark, Copenhagen.

GRATTAN, DAVID W.
1982 A *Practical Comparative Study of Treatments for Waterlogged Wood, Part II. The Effect of Humidity on Treated Wood*, Proceedings of the ICOM Waterlogged Wood Working Group Conference, ICOM Committee for Conservation, Waterlogged Wood Working Group, Ottawa

HOFFMAN, PER,
1982 *Chemical Wood Analysis as a Means of Characterizing Archaeological Wood*, Proceedings of the ICOM Waterlogged Wood Working Group Conference, ICOM Committee for Conservation, Waterlogged Wood Working Group, Ottawa 1982, p. 83.

HOFFMAN, PER
1984 *On the Stabilization of Waterlogged Oakwood with PEG Molecular Size Versus Degree of Degradation*, Waterlogged Wood: Study and Conservation, Proceedings of the 2nd ICOM Waterlogged Wood Working Group Conference; Grenoble, Centre d'étude et de Traitement des Bois Gorges d'eau - Grenoble; pp. 95-115.

HOFFMAN, PER
1984 *On the Stabilization of Waterlogged Oakwood with PEG II. Designing a Two-Step Treatment for Multi-quality Timber*, Studies in Conservation, Vol. 31, No. 3, Aug. pp. 103-113.

SEGAL, MARTHA; MACDONALD, MAUREEN
1984 *Current Research into the Conservation of Frozen Skins from the Arctic*, ICOM Committee for Conservation Preprints, 7th Triennial Meeting, Copenhagen, pp. 14-18.

WATSON, JACQUI
1982 *The Application of Freeze-Drying on British Hardwoods from Archaeological Excavations*, Proceedings of the ICOM Water logged Wood Working Group Conference, ICOM Committee for Conservation, Waterlogged Wood Working Group, Ottawa, pp. 237-242.

YOUNG, GREGORY; WAINWRIGHT, IAN N.M.
1982 *A Study of Waterlogged Wood Conservation Treatments at the Cellalur Level of Organization*, Proceedings of the ICOM Waterlogged Wood Working Group Conference, ICOM Committee for Conservation, Waterlogged Wood Working Group, Ottawa, pp. 107-114.

YOUNG, GREGORY S.
1986 IIC-CG Conference Presentation, Winnipeg (not published).

YOUNG, GREGORY S.
1986-87 *The Potential of Shrinkage Temperature Measurements in Skin and Leather Conservation*, ICOM Ethnographic Materials Working Group Newsletter.

JUDITH A,. LOGAN
CANADIAN CONSERVATION INSTITUTE
1030 INNES RD.
OTTAWA, K1A - OM8
ONTARIO, CANADA

GREGORY S. YOUNG
CANADIAN CONSERVATION INSTITUTE
1030 INNES RD.
OTTAWA, K1A - OM8
ONTARIO, CANADA

LARRY MURPHY

Recent Preservation Efforts on USS *Arizona*, Pearl Harbor

USS *Arizona* was sunk at its mooring during the Japanese attack on Pearl Harbor, Hawaii on December 7, 1941, with a loss of 1,177 sailors and marines. More than 1,100 men remain entombed within the wreck. Extensive damage sustained by the battleship precluded the possibility of salvage, and the hulk became a widely recognized symbol of the Pearl Harbor attack during and after World War II.

A memorial building spanning the wreck was completed in 1962 and commemorates the Pearl Harbor attack and resulting casualties. The striking white concrete, steel and marble structure, designed by Alfred Preiss, receives between 1.2 and 1.5 million visitors a year. In 1980, a new visitor center was completed and the *Arizona* Memorial became a unit in the National Park System. The National Park Service (NPS) assumed responsibility for its operation, while the Navy retained ownership. NPS is also responsible for maintenance, interpretation and preservation of the memorial.

In order to develop a long-range management strategy, NPS Superintendant Gary Cummins initiated a phased project to study the shipwreck. The multidisciplinary project planned to integrate historical preservation and park interpretation goals, and draw assistance from various professional communities, eventually including archaeologists, illustrators, historians, marine biologists, engineers, Navy salvage divers, and volunteer divers. Dan Lenihan, chief of the NPS Submerged Cultural Resources Unit, was asked to bring his team of underwater archaeologists and illustrators from the mainland to head the operation.

In 1983, the first phase of the evaluation of USS *Arizona* was begun. The objectives were to conduct an extensive underwater survey and mapping operation that included photographic and video documentation to determine exactly what remained of the ship. Contemporary Navy salvage operations conducted in the four years following the sinking had removed most of the superstructure and armament. No diving operations had been conducted on the wreck since the completion of Naval activities in 1945, and no maps of the underwater features of the wreck remained from the salvage dives.

The brief reconnaissance survey and preliminary map of the wreck, completed in 1983, resulted in some significant findings. The entire forward turret with its 14-inch guns was located intact; there was no evidence of torpedo entry holes observed in the hull; the source of oil leakage was discovered; and perhaps of most interest to managers, live ordnance was found lying in the deck rubble directly under the memorial structure. Naval Explosive Ordnance Disposal divers removed the ordnance.

In 1984 data collection was completed for a series of detailed drawings that would serve as an interpretive device and a baseline for future studies. The data collection was a cooperative effort between the National Park Service and the U.S. Navy. The funding was provided by the Arizona Memorial Museum Association, a private support group. The final product, a five-view graphic presentation of *USS Arizona* (Figure 1), won for the National Park Service the 1985 John Wesley Powell Prize for Historic Display by the Society for History in the Federal Government.

Phase II of the project, which took place in July 1986, was initiated by Bill Dickenson, who had replaced Cummins as superintendent of the Memorial. One objective was to obtain additional data to construct a model of the ship as it appeared on the bottom, which had been proposed to augment interpretation of the site for memorial visitors. The graphic presentation of the wreck required more detail for the modeler, and it was also necessary to document the debris on the bottom of the harbor and the nearby mooring quays to enhance the display. The revised map derived from the underwater operations was the principal data source for the model builder. The map would also serve as a baseline for monitoring the deterioration of the hulk. Although this objective involved only follow-up using procedures and techniques developed in Phase I, the second of Dickenson's objectives was much more complicated: he wanted to begin a program that would eventually result in understanding what was happening to the ship's fabric.

After the question "What is there?" was answered in Phase I, the next logical query was "What's happening to what's there, and what are the implications of the deterioration process for public use over time?" — a far more complex issue. No one had previously confronted the problem of developing a long-term preservation program for a whole ship in situ. More important, no one had even addressed the issue of whether a submerged war grave (the hull, not the memorial) should be preserved. Whether or not the management decision was made to interfere in the natural process of deterioration, the baseline of data would be necessary.

Archaeological conservators have developed many successful techniques for the stabilization and conservation of individual materials removed from a marine environment, but the conservation problems inherent in a complete steel hull 600 feet long and 100 feet wide, immersed for 45 years in a rich biological and chemical soup is new territory. Experience with materials from historical marine shipwrecks indicates that most ferrous materials are protected from continual corrosion by the formation of encrustation, a complex interaction of chemical and biological processes. Encrustation substantially reduces or stops active corrosion. Furthermore, encrustation can occur in semi-tropical waters in as little as five years. The corrosion rate for unprotected steel in seawater is commonly given as .005 inches per year. It became clear to the USS *Arizona* team that preservation efforts of the shipwrecks remaining in Pearl Harbor inevitably had to answer questions about corrosion and encrustation processes. A first cut research design was formulated to answer the initial questions and develop additional questions to guide future preservation research on the shipwrecks.

Dan Lenihan was overall project director of the 1986 fieldwork. The principal objectives of the study pertinent to site preservation were to:

1. Develop a baseline inventory of biological communities on the structure of *Arizona* relevant to determining the biochemical processes impacting the vessel fabric.
2. Obtain quantifiable measurements of the state of deterioration of metal structural elements at selected points on USS *Arizona*.
3. Complete a reconnaissance level survey and controlled sketch of USS *Utah*, the only other remaining vessel that is an element of the Pearl Harbor National Historic Landmark.

Dickenson and Lenihan developed a series of specific questions relevant to the first two objectives. When Dickenson became aware of a local expert on marine fouling processes, Scott Henderson, who had conducted prior research in Pearl Harbor, he contracted for biochemical analysis. Henderson, a civilian marine biologist working for the Naval Ocean Systems Center of Honolulu, developed a series of hypotheses and test implications for application during the field session. Some of the biological observations that follow came from his preliminary report.

A secondary objective of the 1986 operations was to determine the utility of directing U.S. Navy reserve training exercises to research

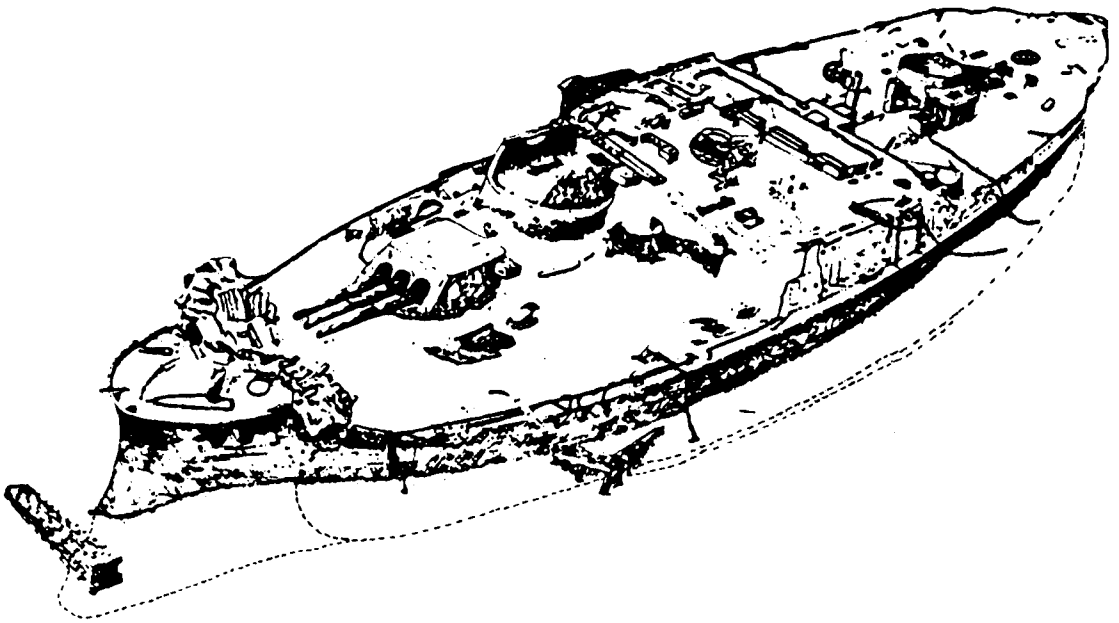


FIGURE 1. Perspective View from the Bow

on submerged cultural resources under the direction and supervision of professional researchers. The reserve Mobile Salvage and Diving Unit (MDSU) from Long Beach (Det. 319), under the command of Otto Orzech cooperated jointly with NPS divers to collect appropriate data from both USS *Arizona* and USS *Utah*.

Arizona was analytically divided into horizontal and vertical surfaces based on an examination of the 1984 base map. Sixty-one vertical points were selected by Henderson for observations of biofouling composition and thickness, which provided 20 transects of three observation stations each, split equally between port and starboard locations and evenly spaced on the hull side. The stations included both hull and superstructure elements. Twelve of the vertical stations were selected for installation of a permanently mounted pair of supports that now serve as a registration device for an underwater camera mount. The photo station mounts allow a camera to be repositioned exactly so that close-up photographs can be taken to record biofouling changes over time. The vertical photo stations are a key element in the long-term site monitoring program under development.

Twenty-five common taxa of fouling organisms were observed and recorded. Over 99 percent of the vertical surfaces are estimated to be covered with encrusting organisms. The hard-fouling encrustation layer, averaging well over 3/4-inch thick, is primarily composed of oyster and vermetid shells, which provide a substrate for secondary growth of sponges and tunicates. That hard encrustation layer forms a protective barrier for the underlying steel fabric and reduces the corrosive effects of seawater. The encrustation layer maintains an anoxic environment against the exterior steel surface that promotes the formation of stable oxides and, presumably, significantly reduces cathodic reaction and corrosion. Apparently the inner layer of encrustation, originally composed of calcium carbonate, is replaced by ferrous corrosion products bonded to the underlying steel.

The USS *Arizona*'s vertical surfaces were observed at 55 locations selected from the base map. Each observation station was marked by a weighted and sequentially numbered plexiglass square to allow future observations during site monitoring. At each station a series of observations were made. Sediment depth, composition, and types of biota were recorded. In addition, where the overlying sediment was less than 1 foot thick, a small area was cleared to determine the condition of the substrate, which in most cases was found to be teak deck.

The overburden was composed of various combinations of sand, rubble from oysters and vermetid worms growing on nearby vertical features, and mud and silt. The shallower areas of the hull contained primarily sand and rubble, the deeper portions more mud and silt. The underlying teak deck was found to be smooth and dense in most areas, although some damage by burrowing mollusks was noted, particularly where the sediment was thin. One unexpected impact to the remaining wood deck was observed: Over 100 areas were noted where the sediment had been cleared by the fanning actions of egg-laying fish. These nests, 1-3 feet across, expose the underlying teak deck to the action of burrowing mollusks.

Researchers selected 12 areas on the hull and superstructure for measurement of metal and corrosion thickness. These data were col-

lected for use by corrosion engineers in establishing corrosion rates. The original research design had specified that small representative samples of steel fabric would be removed from the ship for laboratory analysis; however, clearance was not granted, so no samples were taken. In the future, fabric ananlysis will comprise an important research focus for corrosion engineers.

Corrosion and the biofouling process are affected by numerous water quality attributes, chiefly oxygen, pH and motion. In order to determine the corrosion rate of interior spaces, the chemical and biological conditions were assessed. Divers made biological observations visually through the hull openings, primarily portholes. No interior spaces were entered, but adequate observations of fouling were made with an underwater light. Biological fouling was found on fewer than 50 percent of the observable surfaces. Oysters and vermetid worms occur only in a very patchy distribution on the observable interior surfaces.

It was assumed that the interior spaces would exhibit lowered oxygen and pH levels compared to the ambient harbor water, as a result of the microbial and corrosion process couple with reduced water motion. A pvc probe was constructed so that water could be pumped directly to a surface wet well containing oxygen, pH and temporary probes. The diver inserted the pvc probe into the interior spaces to a distance of 15 feet. The measurements were taken and samples of the interior water were collected and chilled for determination of the presence of sulfides and hydrocarbons.

There were no exfoliating layers, which would indicate active corrosion, observed in the interior spaces. The dissolved oxygen was found to be significantly reduced in the interior spaces. As would be expected, the areas closest to the opening exhibited some flushing activity. PH was only slightly reduced in the interior. Petroleum products were observed in some of the interior spaces and were brought up in the probe samples. The main concentration of hydrocarbons seem to have sunk to the lower level of the spaces. The combination of reduced oxygen and presence of hydrocarbons apparently reduce the corrosion rates within the hull itself and may compensate for the limited protection offered by the biological fouling.

In addition to the biochemical observations, a bathycorrometer was utilized during the project. A bathycorrometer gives an indication of the galvanic activity present. The unit is a diver-operated instrument that measures the electrical potential difference between the structural steel and a silver chloride reference electrode, then gives a digital readout in millivolts. The bathycorrometer data have been turned over to metallurgical engineers at Pearl Harbor Naval Shipyard for analysis.

The cooperation between archaeologists and marine biologists has produced important baseline data, and managers have committed to an ongoing monitoring of the observation stations established during this field work. Although this has been a significant beginning, it is just the start. Before there is sufficient data for management to make a decision regarding the long-term preservation program of the shipwrecks of Pearl Harbor, more information is needed.

The experience of archaeological conservators with the conservation of metal hulls in situ is limited, and the literature is scanty. The problem of conservation and preservation presented by USS *Arizona* and USS *Utah* resembles the problems faced by those concerned with corrosion of floating ships and submerged structures more than the problems faced by archaeological conservators in a laboratory. Proposed future research plans include the use of non-destructive techniques for determining the thickness of the hull plates. Samples of the anaerobic sediments surrounding the imbeded hull will be taken to determine the nature of corrosion products present. NPS will request clearance for the removal of fabric samples, and the multidisciplinary research will be expanded to include the active participation of corrosion engineers, metallurgists and other specialists and their respective laboratories.

As the Pearl Harbor field work makes clear, both the USS *Arizona* and USS *Utah* exist within a complex biological and electro-chemical environment. The preservation program for these historic vessels depends on understanding, and, perhaps, eventually manipulating this environment. Additional measurements are needed to complete the initial step in understanding the environmental context of the Pearl Harbor shipwrecks. The data will be used to begin the process of research design formulation to determine the life-span of the hulls if no action is taken and to determine what further tests and experiments are necessary to develop appropriate conservation procedures to prevent further deterioration of the vessel fabric, should that option be adopted by management.

The ramifications of the research on the Pearl Harbor shipwrecks go far beyond those sites. Many important iron and steel vessels are submerged world wide, and the preservation of those vessels in situ may be the only viable alternative to their eventual disintegration.

LARRY MURPHY
SUBMERGED CULTURSL RESOURCES UNIT
NATIONAL PARK SERVICES
P.O. BOX 728 FE, MN 87504

SYMPOSIUM

CAROL OLSEN

New Potential for Nautical Archaeology through Public Relations

Public relations is broadly defined in this discussion as interaction with media, public outreach including marketing of educational materials, fund raising, and other ways in which we can enhance the identity and credibility of individual projects, and the field of nautical archaeology in general.

In the Library of Congress, from splendid marble walkways, visitors literally look up massive classical columns to the permanently inscribed words "HISTORY" and "ARCHAEOLOGY." Many quotations along these hallways emphasize the importance of cultural heritage and gaining knowledge, and it is anticipated that in 1987 and beyond, television coverage may help to emphasize these values through the field of nautical archaeology. Upcoming programs include a Walter Cronkite special, George Bass' film on the Kas wreck, and BBC's 8-part series on nautical archaeology.

1986 brought this country a heightened awareness of maritime activity. Among spotlighted events were the glory of the July 4th Operation Sail in New York, and the tragedy of the sinking of the *Pride of Baltimore*. In underwater projects, *Titanic* held headlines, and in addition to ongoing professional excavations, salvage projects became especially big news.

Of one operation, the New York Times wrote: "The public interest would have been better served by leaving the wreck alone until it could be properly excavated by underwater archaeologists." The project described was the 18th c. HMS *DeBraak*, found 2 miles offshore near Lewes, Delaware. A few miles away, a town museum has long shown a model of Delaware's most famous wreck, *DeBraak*, which sank in 1798; the vessel was said to be carrying gold when she went down in a sudden squall.

To recover that gold, salvors claiming to have found *DeBraak* about two years ago, began to excavate under the aegis of various permits from the Corps of Engineers and the State of Delaware. In those two years, I am told, there has been some general recording of artifact provenience, and with scarcely any discovery of gold.

And then about 4 months ago, a 70' surviving portion of the 84' *De Braak* hull was hauled from the ocean and place on a metal barge. Much of the wood preservation is admirable, with the planking still fitting very tightly together, and at least one section of interior timber containing etched graffiti. Interior hull details that I saw included remains of the mast step and shot locker.

Exterior features include large staples at the keel, and stamp-dated copper sheathing. There are myriad other interesting and instructive details to be gained from these hull remains, yet at the same time one sees the unnecessary damage to this artifact: the keel has been twisted out of shape by salvors who set this wood down on a barge without any support. Modern steel lifting cables sliced into the hull, needlessly tearing the wet wood several feet in many places, and interior sections fell out of *DeBraak* when she was raised. I am told that part of the stern section was lost as well. Although a metal cradle was constructed to help lift *DeBraak*, no one used it, and I am told that the salvors always controlled these decisions because they paid for the work.

Further, in raising the hull to look for gold that might be under the vessel, I understand that artifacts from the ship spilled to the seafloor. To recover them, a clamshell bucket was used. We can only speculate about what caused this sudden change in technique, but the effect is demonstrable.

At the *DeBraak* site, I saw one barge take the clam-shelled material to another barge where it was off-loaded with a front-end tractor. The site material then went into a hopper, or rock separator, usually used for road construction, and from there the *De Braak* material moved along a conveyor belt to an area where it was showered down, and the salvors could pick out what they wanted. One estimate was that they were retrieving about 40% of the artifacts going by them.

The fine quality of the artifacts from the site was demonstrated long ago, with materials such as a well-preserved handgun, a wig or possibly a human scalp (reports have varied), and well-preserved leather boots.

But there were problems even with the recovered artifacts. Although some were cleaned and labeled, they didn't sit far, for example, from the ship's pump that the salvors had taken apart without first drawing its assemblage. Now they are unable to put it back together. This is just one example. The United States simply must get on with addressing the standard to be required in the recovery of scientific information.

Salvage project directors, like Kevin McCormick at the *De Braak* site, make ample use of press coverage focused on potential gold discoveries, and we know that this is an important tool with which some salvage companies attract investors. But let us move on to discuss ways in which a more academic viewpoint may be expressed about nautical archaeology in general.

One of the most important events in 1986 was the workshop on nautical archaeology hosted by the Office of Technology Assessment, which advises Congress. The final report on nautical archaeology was edited by Ray Williamson, and this was, I believe, the first report ever to go to Congress to tell them about the technological and financial needs of nautical archaeology and it stressed that improved legislation is critical.

Also, Congress has recently given funds for the National Park Service and the National Trust for Historic Preservation to do an inventory of maritime resources, including all of our known historic shipwrecks.

It should be worthwhile here to elaborate a little on the National Trust for Historic Preservation, which has its headquarters in Washington DC. Currently we are developing with Partners for Livable Places an outline for a workbook and course to help state managers deal more effectively with shipwreck projects. We believe that Delaware handled the *De Braak* project as they did because they were on weak legal ground, and because they needed help and were not sure where to get it.

Partly in response to this, staff in many National Trust departments are also already involved in shipwreck issues in many ways. For example, Marcia Myers, our Vice-President for Maritime Preservation, is involved in some aspect of shipwreck issues on almost a daily basis. In Government Relations, lawyer Kate Perry is contacting the Corps of Engineers to see how the permit process can be improved beyond that which was used for the *De Braak*. Head of the legal department, David Doheny will host a preservation law conference in 1987, to include shipwreck issues, and working with him is staff counsel Tom Mayes who has been developing expertise in this area of law; he has been especially helpful regarding the Shipwreck bill. Additionally, attorney Elizabeth Merritt will include an article on shipwreck looting in the next Preservation Law Reporter, the professional journal which she edits.

Shipwreck articles have also appeared in the National Trust's quarterly magazine, HISTORIC PRESERVATION, which is edited by Jeff Colin, and Margaret Heimbold, head of the Trust's book

publications has expressed interest in nautical archaeology issues.

Steve Pike, head of marketing, has shown me for the USS *Monitor* Project, a number of ways in which educational materials can be produced at no cost, yet with profits of sales going to the Project. And, another key person is Jim Jordan, head of Public Policy, who is helping us to bring nautical archaeology issues to the attention of more people on Capitol Hill.

Finally, Carl Nelson is with the Trust's public relations office. His department's expertise is working with the media, producing public service announcements, and handling Preservation Awards, which I might add, need more maritime nominations from you. Awards help to create new heroes, and maritime could use a few. more.

And now, turning to some of the things all of our offices can do. Instead of so often working alone, we should look for more opportunities to piggyback with other events, so that we can spend somebody else's money to get our message across. This is easier to do when you have a portable display that explains your organization and projects. A recent piggyback opportunity appeared for the USS *Monitor* Project. Since she is a Civil War vessel, I contacted the people who are organizing the many Civil War battle re-enactments over the next few years. Each of their events will draw tens of thousands of visitors. The *Monitor* Project, they say, can set up information in their display areas, and even sell educational materials to an audience that cost the *Monitor* Project absolutely nothing to attract.

I also recommend looking in the Encyclopedia of Associations for ideas about who you want to reach. For example, again, for the ironclad vessel *Monitor*, it seemed a good idea to contact the Iron & Steel Society; they have a membership of several thousand and a budget of a few million dollars. When they held their annual conference in Washington last year, they agreed readily to the display of material, and the *Monitor* Project is pleased to have a large, distinguished Society like this interested in their work.

There are many opportunities: boat shows, waterfront festivals, community activities, and it is important to know the options and to plan for them.

Permanent displays are especially helpful since they can work 24 hours a day for your project. For example, one was built at the airport near Texas A&M University. The large display construction, photograph, and label costs were covered by local companies which were acknowledged as donors. Hopefully travelers here, and particularly those who could make financial contributions, more often leave the airport now talking about nautical archaeology because of this exhibit.

We would be wise to always be on the lookout for new display opportunities. There really are many, from having your brochures available at your local Chamber of Commerce to perhaps a temporary display in a local bank or visitors center.

We should take the opportunity to communicate and educate on the air, by providing an outline of issues and suggested speakers to National Public Radio. There are also opportunities such as this: when I hear on the morning news "Tune in tonight at 6 o'clock when we interview a treasure-hunter," I call the newscaster, and say that I just want to be sure that that person is aware that a very large preservation community has concerns about salvage projects including excavation techniques, long-term conservation plans, selling artifacts, treatment of human remains, etc. I have found reporters very receptive, and willing to raise those issues in their live interviews later in the day. To be professional, they need to treat issues fairly, and we have the opportunity to help them.

We can also offer suggestions to networks about programming. For example, each year, National Maritime Day on May 22nd goes largely unnoticed. Instead, we could be letting stations know that it is upcoming, and offer suggestions for speakers and topics. We could also help the media make more ado about Preservation Week, which is the 2nd week each May. These are readymade hooks for us to hang our hats on.

Further, we can create our own media opportunities. For example, when the *Monitor* anchor had completed conservation treatment, a press photo opportunity was arranged. The head of the Marine Sanctuaries office unveiled the finished artifact, and a press packet was distributed, which covered broader issues of the Project. However, while program representatives certainly have stature, people really love to hear from movie stars. I understand that Harrison Ford, who played the archaeologist in Raiders of the Lost Ark, has been asked to do a public service announcement asking people to protect archaeological sites.

Politicians also draw the press, and there is no question that we would benefit by inviting more legislators to our conferences and for on-site visits. I also think that every year we should have at the CUA a report on key political players and their positions on maritime matters.

Some prominent people may surprise us with the strength of their advocacy for maritime preservation. At Op Sail in New York a few months ago, Secretary of the Navy John Lehman made some beautiful remarks about the importance of historic ships, and allies of his caliber should not be overlooked.

The press also pays attention to large numbers of people, and as we work on a coalition with more preservationists, our voice is becoming stronger. In particular, we are thinking about future hearings on legislation to protect historic shipwrecks.

It should be known that the 1985 shipwreck bill hearings were a media event. The elegant room in which they were held had cameras set up, there was a special table for reporters, and a staff at a long table in the hallway monitored an array of electronic equipment. Bob Ballard was among those very much in the limelight because of the *Titanic*

The media wants us to paint an interesting picture with our words. A producer of an upcoming program told me that the message, whether it was pro-salvage or archaeology didn't matter. What did matter was that the language was interesting enough to hold an audience. She said give us analogies, like that story you tell about a shipwreck being as precious as Mt. Vernon, and that it wouldn't do to bulldoze that house even if it were sitting on the Mother Lode.

Actually, many marine archaeologists are more than quotable. And I hope that more often our remarks will celebrate our successes, such as the permanent nautical archaeology displays currently in museums, the cooperative efforts with sportdivers, and our educational programs and publications.

And as we know, money can be a factor in our success. Many of you are connected with universities, and I would encourage you to know and work with people there who have expertise in public relations, development, and marketing. There are likely many opportunities that their professional experience could envision for your project. Use it. And do keep on file newspaper articles about your projects. They are important for fund raising, as well as licensing if your project is going to be big enough to do that.

Licensing involves selling educational materials and this can even be "T"-shirts, with somebody else covering all of the costs and then donating part of the profits to your project. The point I wish to stress is the importance of keeping a good record of the press coverage that you are receiving.

Also, we should all be planning five years ahead, and doing a funding assessment now for those future financial needs. Work with development people to see what foundations, corporations, and

individuals could provide support, and put those names on your mailing list now. Do not wait until you send a proposal to try to get to know them.

And think creatively about possible support. For example, the *Monitor* was known as the Cheesebox on a Raft. I have wondered if Kraft Cheese might be interested in being one of the Project's corporate donors.

Think also about getting help organizing a fund raising event. It would be especially helpful if a prominent person would agree to host the event, and think of something exclusive you can offer your guests. For example, it occurs to me that the distress lantern, now recovered, was the last light seen on the *Monitor* before she went down 125 years ago. With the help of a tiny bulb set inside, one party of guests could be the first to again witness light from that lantern. It would be a simple gesture, involving no cost, yet it would also be an exclusive, and one-of-a-kind little event that no one else could offer.

Besides the more lavish events that one could consider, grass roots support is a key to success. Here are some examples of public interest in the *Monitor* that have especially caught my attention. For example, in New York, the John Ericsson Society constructed a parade float of the *Monitor* with a John Ericsson look-alike riding at the bow. The Ericsson Society also has an annual ceremony at the John Ericsson statue on his birthday, and each year they get official proclamation of John Ericsson Day. The Ericsson Society also provides cash prizes to children of their winning posters about Ericsson's great invention, the USS *Monitor*.

This type of support is priceless to a nautical archaeology project. Not only can foundations clearly see this public interest, but it has also been mentioned in a recent letter to the U.S. Postal Service asking for a commemorative stamp for John Ericsson. Such a stamp, of course, would not be of great educational value, but it would add to the national attention of the *Monitor* Project.

Also, an artist donated to the *Monitor* Project a design for a cachet and pictorial cancellation. This is educational material which may be sold, in part, through some National Park Service stores. There are a lot of ways to blend media coverage, public support, and fund raising.

In conclusion, the National Trust for Historic Preservation, currently with a membership of 178,000, wants in 1987 to begin a public awareness campaign for nautical archaeology, and we are fund raising for that effort. Particularly because of the way in which the Trust is now and plans to do future work on behalf of nautical archaeology, I encourage you to become National Trust members; we have a special joint membership with the National Maritime Historical Society in New York, which also includes a subscription to SEA HISTORY.

Working together is one of our most important tools, and I hope that our network will be strengthened. We encourage you to keep the Maritime Department at the National Trust for Historic Preservation aware of your reports, news clippings, and information about legislators. Not only will we read this material in the Maritime Department, but we will forward copies as appropriate, to others within and outside of the Trust. We believe that with a lot of us working together, there clearly is new potential for nautical archaeology through the complex and interwoven avenues that constitute public relations.

CAROL OLSEN
NATIONAL TRUST FOR HISTORIC PRESERVATION
1785 MASSACHUSETTS AVENUE N.W.
WASHINGTON, D.C. 20036

SHELI SMITH

Communicating Archaeology: Visual Communications of Archaeology with the Pen

Illustration was the first graphic tool used by archaeologists to record, illustrate, educate, and create mood. Although illustration is no longer the only graphic tool, its position in the archaeological investigation has not been diminished, only enhanced. Illustration is a broad category covering cartography, artifact documentation, educational schematics and graphs, as well as pictorial scenes. Within each division are subdivisions. For instance, locator maps, site plans, artifact distribution plans, and profiles are all considered part of cartography.

Each step of an investigation requires some application of illustration, possibly alone or in combination with other graphic tools. Step by step the illustrative needs of the initial proposal, public relations, out reach programs, survey phase, excavation phase, and publication phase must be considered. A thorough list of proposed illustrations is helpful in further planning, budgeting and directing the various investigative phases. Once the list is formed the methods of presentation can be decided. India ink and mylar are no longer the sole tools of the illustrator. Computer generated graphics are well suited for cartographic and graph production. Color enhancement is becoming affordable. Careful selection of color shades will allow the illustration to be as powerful in black and white as it is in color. Using the cartographic color scale, color coded artifact distribution maps can project depth, as well as the normal two dimensional axes.

Cartographic illustrations are usually the first category utilized. Locator maps, site plans, artifact distributions plans, and profiles are useful products on several different levels. Locator maps, site plans, and profiles help present the archaeological site in its full range from general to specific context. It is important to keep the full range in mind when outlining graphic needs. For example, locator maps can aid the researcher and audience in placing the archaeological site in a local, regional and global context. Overall site plans, artifact distribution maps and profiles are very useful in projecting varying views of the same area. Using acetate overlays helps researchers compare different artifact associations and contexts (Figure 1). Another important division among maps is field or working maps versus publishable illustrations. Consistent scheduling for compilation of field maps helps form a sound foundation for the final maps. Although field maps are not generally published they can be useful public relation and education tools. However, it is wise to put "PRELIMINARY" in the titles of these illustrations so as not to confuse those unfamiliar with the archaeological process.

Artifact documentation is an equally important division of illustration. Like cartography this facet of illustration can serve a variety of functions. First, artifact illustrations realistically document in scale exact size and shape of an object. Second, artifact illustrations

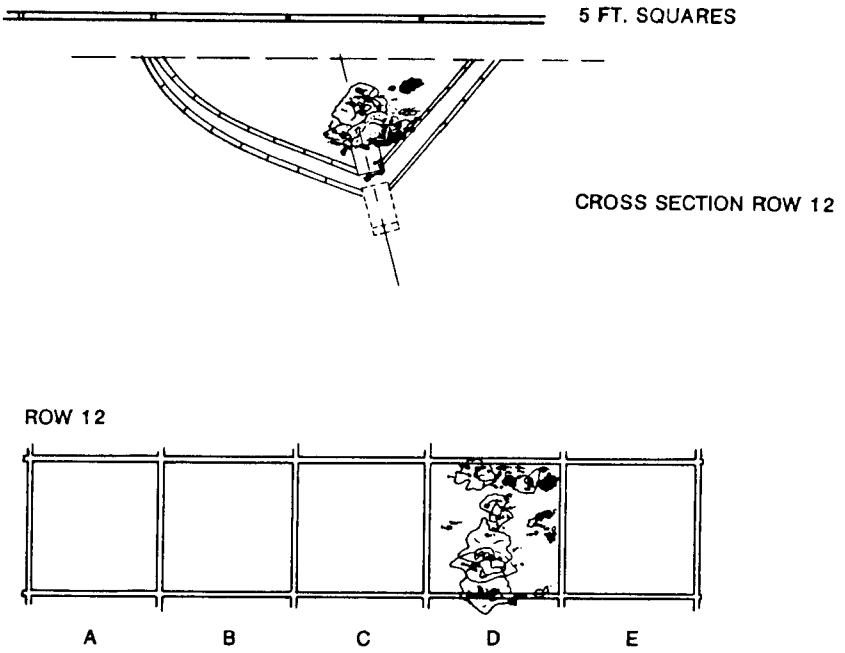


FIGURE 1. Illustrations can be general or specific. They can also combine two or more perspectives (courtesy of the *Defence* Project).

can sometimes capture nuances of design and texture not always apparent to the camera eye (Figure. 2). Furthermore, illustrations can define thickness and features which are not seen but reconstructed through cross-sections . Beyond a purely scientific document of an object, illustrations of oblique angles and groups of artifacts present a pleasing picture.

Graphs and cartoons form the third division of illustration and are used most often to define and inform. Graphs efficiently present relationships of large amounts of data which would otherwise be awkward presented in text form alone. However, graphs are the most misused tool of illustration and can easily confuse or mislead the audience. Use graphs judiciously and always apply the K.I.S. principle — KEEP IT SIMPLE.

Cartoons or schematics are an older tool of the illustrator primarily used prior to the advent of photography. Yet, in recent years this form of illustration has enjoyed renewed popularity. Cartoons are particularly helpful in defining sequence of construction or destruction events, similar to the way a picture cookbook visually explains a recipe. Schematics can compress a series of events or cross over several mediums at once. For instance, a schematic displaying a remote sensing survey technique such as side scan sonar can show what is happening above and below water while simultaneously defining specifics such as beam width which is invisible (Figure 3).

The final tool of the illustrator is the pictorial scene or artistic rendition. Generally, this division of modern illustration is used to create mood. It is primarily adapted to imaginative recreations of some aspect of cultures past. Exaggeration in scenes is common and purposely placed by the artist to enhance a description or narration in the text. On the other hand, the use of the historic artistic rendition

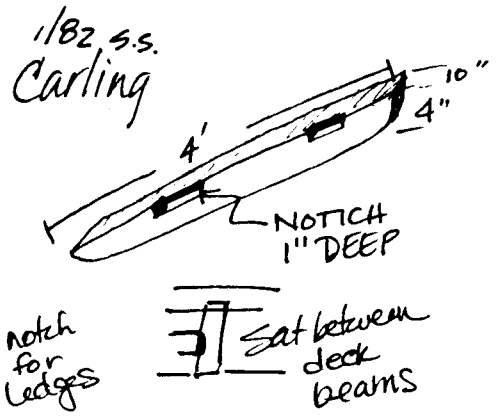


FIGURE 2. Traditional artifact illustrations are powerful documents of an artifact alone or in combination with photography (courtesy of the *Defence* project).

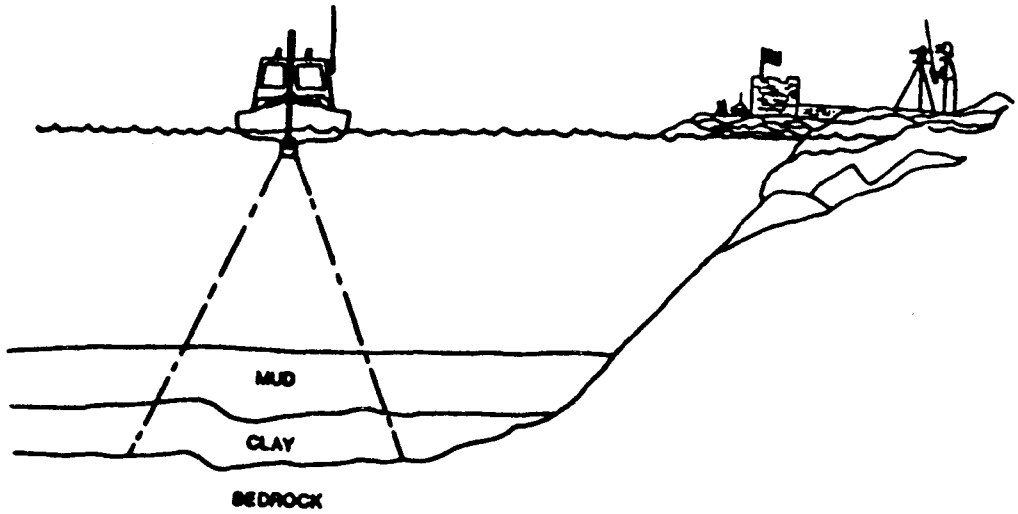


FIGURE 3. Schematics range from the highly technical rendition to cartoon-like drawings, but they are always packed with information (courtesy of the ANGEL GABRIEL Project, MAHRI

is as a comparative example. Many historical paintings and illustrations capture details about objects and events which are helpful comparisons for archaeologists.

Each division of illustration can enhance the communication of archaeological information. However, there are pit falls and only through careful planning can most of them be avoided. Be sure to clearly define the purpose of each illustration and definitively separate the drawings which are meant to inform from the drawings which are meant to entertain. Avoid expecting one illustration to serve too many purposes. Cluttered maps and drawings are usually ignored by the audience and thus lose their impact. The words "clear and concise" are as important to illustration as they are to writing. Successful communication of archaeology depends on the comprehensive use of both graphics and well formed prose.

SHELI SMITH
11737 21-A JEFFERSON AVE.
NEWPORT NEWS, VA 23606

SYMPOSIUM

RICHARD W. LAWRENCE

Location and Identification of the Steamboat *Spray*

Introduction

The 1981 project that resulted in the location and identification of the steamboat *Spray* was unique in a number of respects. The project was initiated by the North Carolina Underwater Archaeology Unit as part of the environment review process. Although this in itself is not unusual, due to a number of bureaucratic problems, the project involved both state employed and private archaeologists working on a cooperative basis. Second, using a combination of historical, bathymetric, and magnetic data, two-thirds of the magnetic anomalies detected during the remote sensing survey were eliminated from needing further investigation. This was an extremely important time saving measure in dealing with an urban waterfront environment where anomalies caused by modern debris or structures were numerous, the visibility limited, and much of the bottom covered by a thick layer of sediment. In addition, the project participants were able to locate and evaluate the source of two buried magnetic targets using a high pressure water probe, eliminating the need for time consuming and costly excavation of these sites.

The project also resulted in the identification of a wreck site, the steamboat *Spray*, from historical information on a vessel's design and construction not from records of its loss - the circumstances surrounding the sinking of the *Spray* are still a mystery. Finally, documentation of the remains of the *Spray* revealed a previously unknown method of hull construction, the use of iron bands on the exterior of the hull as the primary means of structural support.

Description of work

In the spring of 1981 the American Coal Company submitted plans to the State and Federal review agencies for the construction of a major coal exporting facility to be located on the Northeast Cape Fear River immediately upstream of Wilmington, North Carolina. In addition to the construction of extensive docks, warehouses and a railroad system, the plans called for the dredging of approximately 25 acres of river bottom. The dredging was designed to deepen the existing 300-foot channel from a depth of 25 feet to a depth of 35 feet and to construct a 1,000-foot-wide, 2,500-foot-long turning basin and berthing area.

Since the project represented a major bottom disturbance and was situated in an area with a long history of land and water use, the Underwater Archaeology Unit of the North Carolina Division of Archives and History recommended an initial investigation be conducted to include both historical research and a remote sensing survey. Due to a number of factors the Underwater Archaeology Unit did not see the construction plans until late in the review process, after a Corps of Engineers permit for the work had been issued. As a result the Division of Archives and History and the American Coal Company entered into an agreement to jointly undertake the necessary work. A historical overview of the Northeast Cape Fear River and the project area was compiled by Division of Archives and History staff historian, Dr. Wilson Angley, and the American Coal Company contracted with Allen R. Saltus, of Archaeological Research and Survey, to conduct a magnetometer and bathymetric survey of the project area.

Although no specific records could be found of shipwrecks in the project area, Dr. Angley's report confirmed the extensive industrial and maritime use of this portion of the river. From the Colonial period until the early twentieth century the Northeast Cape Fear River, which is navigable for over 100 miles, served as a major artery of transportation and trade between the plantations and communities along the river and the Port of Wilmington. In addition, the research found that the upland area, including and surrounding the proposed coal facility, had been the scene of a variety of enterprises including: a ferry crossing, two railroad bridges, rice plantations, saw mills, lumber yard, fertilizer plants, molasses warehouse, ice company, guano company, shingle mill, and cotton compress. The physical remains of these activities are still evident today. In recent years a marine dry dock facility, an iron salvage yard and several chemical companies have operated in the nearby vicinity.

The magnetic and bathymetric survey was conducted by Saltus and his crew during September, 1981. After completing the field work a computer system was used to process the raw field data and bathymetric and magnetic contour maps were produced.

Although the magnetic contours were distorted by surrounding ferrous structures such as the railroad bridge, and the industrial docks, Saltus was able to isolate 36 separate anomalies. Of these he was able to eliminate 24 anomalies as being geological in origin, outside the area of impact, associated with visible modern material, or in areas where extensive dredging has taken place in recent years. Saltus recommended that the 12 remaining anomalies be examined by divers to determine the source of the magnetic disturbance.

As with the initial phase of the project, the Division of Archives and History and American Coal Company agreed to cooperate in the investigation and assessment of the 12 anomalies. The State provided the staff and equipment of the Underwater Archaeology Unit, and American Coal Company retained Saltus as the Principal Investigator.

Prior to the field work the position of the anomalies was calculated from the magnetic contour map. Using an electronic distance meter (EDM) and theodolite, the survey boat was positioned over the calculated anomaly location and a buoy was dropped to mark the site. Water depth in the project area varied from 4 to 30 feet and visability, using an artificial light, varied from 0 to 3 feet. The Northeast Cape Fear River is slightly brackish and has a daily tidal variation of 4.2 feet.

Divers were able to locate the source of nine of the anomalies exposed above the bottom surface, usually within a 6-foot radius of the marker buoy. All but one of these, anomaly K, were found to be caused by the presence of modern debris such as steel cable, iron pipes, steel plating, and chain. At two anomaly locations no material could be found above the soft mud bottom. Although both of these sites were located outside the actual dredge cut, it was felt that post-dredging erosion of the channel shoulder could eventually effect these sites. Cross sectional drawings of the two sites were prepared showing the anomaly location in relation to the 1912 river bottom, the current river bottom, sub-bottom sediments, the proposed dredge cut, and the predicted shoulder slope. In this manner it was possible to determine how deeply buried an object would have to be to avoid project impact.

Systematic probing in the vicinity of these two anomalies was conducted using a high pressure water probe capable of penetrating up to 15 feet of overburden. At one site a 3-4-foot-diameter metallic object was located at a depth of 7 feet and at the other site a 3-foot-by-3-foot object was encountered 9 feet below the bottom surface. In

both cases it was decided that although the anomalies did not represent vessel remains the sites should be monitored to see if they are exposed after the dredging operation.

At the conclusion of the magnetic anomaly investigation it was decided only anomaly "K" warranted further investigation. Initial examination had determined that this site was the remains of the bottom hull of a steam powered vessel at least 80 feet in length. The most prominent feature of the site was the presence of iron straps or bands protruding from the river bottom on both the starboard and port sides at the turn of the bilge. The 1 1/2-inch by 1/2 inch bands were spaced every 15 inches and were found to run athwartships on the outside of the hull planking similar to the hoops on a barrel. For obvious reasons the site soon took on the name of the "Band Wreck".

The final phase of the field work was designed to assess the nature, extent and condition of the remains of the Band Wreck for the purpose of determining the vessel's eligibility for inclusion on the National Register of Historic places. A baseline, marked in 10-foot increments, was established on the wreck starting at the stem and running aft down the keelson. From a point 80 feet aft of the bow it was necessary to excavate 3-foot-by-3-foot test squares every 10 feet in order to follow the keelson and locate the stem post. With the baseline established along the entire length of the vessel, attention was directed toward recording a plan view of the site and structural details of the bow, stem and machinery areas. Vessel cross sections were recorded at 10-foot intervals and surface artifacts were systematically recovered.

At the conclusion of the site testing phase of the project a number of observations could be made concerning the vessel's architecture, and condition.

The vessel measured 133 feet in length between perpendiculars, had an estimated beam of 17 feet 3 inches and an estimated depth of hold of 4 feet 6 inches. The site had suffered considerable structural damage due partly to natural deterioration but also from suspected salvage or dredging activities. Only the keel, floor timbers, keelson, bilge stringers, machinery timbers, and bottom planking remained articulated. Portions of the side hull were found lying on the bottom nearby, but most of the upper hull was missing. The vessel was a sidewheel steamboat, however the boiler, paddle wheel, and one of the two inclined engines, were no longer present at the site. The remaining engine was found 10 feet from its original location.

The most remarkable aspect of the construction of the vessel proved to be the iron bands mentioned earlier. The bands passed between the keel and the keel cap, and followed the outside contour of the hull to the gunwhale. At the gunwhale, the flat strap became a threaded rod which passed through a hole in the gunwhale and was held in place by a nut. By tightening the nuts it would then be possible to draw the hull planking together to prevent leakage. Apparently the designer also used these bands in lieu of internal framing above the turn of the bilge. The few futtocks that were found were spaced 8 to 10 feet apart and were not fastened to the floors.

The vessel's keel was composed of three timbers, a false keel, keel, and keel cap, and measured 6 inches by 16 inches in cross section. The 6-inch-by-6-inch keelson was situated on top of the floors and was fastened to the keel by a 3/4-inch-diameter bolt which passed through each floor. A 6-inch-by-6-inch bilge stringer was located 4 feet 8 inches to either side of the keelson for about half the length of the vessel.

The floor timbers were made from individual 2-inch-by-10-inch planks and were spaced on 21-inch centers. The top edge of the floors was flat and the bottom edge was cut to the bottom hull contour. The floors were notched to rest on the keel cap and had limber holes cut on either side of the keel. There was no evidence of bilge ceiling found in the vessel.

Examination of the intact portion of the side hull, found near the stem, showed that the vessel had external hanging knees that supported an overhanging deck.

A diverse collection of artifacts was encountered and recovered form the wreck site. The spatial distribution of the artifacts helped define functional areas of the vessel. In the after portion of the wreck artifacts were found to be associated primarily with the cabins and passengers. These artifacts include: an abundance of plate glass, ceramic door knobs, brass cabinet fittings, wall mounted oil lamps, ceramic spittoons, and a variety of glassware. Amidships, artifacts were found related to the vessel's engine room including: an assortment of steam and water pipes and valves; bilge strainers; and bearing brasses. In addition a piston-type water pump and the remaining steam engine were recovered. The inclined, slide-valve, steam engine had a 10-inch bore and a 48-inch stroke. The valve chest and cylinder were both severely damaged. The remaining portion of the paddle wheel shaft, which originally connected the two engines, was found but not recovered until May, 1986. In the bow area, artifacts were found to be associated with the crew and ship maintenance. These include: glass and ceramic bottles, tools, small kegs of paint, paint brushes, chain, copper wire, and containers of nuts, bolts, washers and nails. With the exception of two late-nineteenth or early-twentieth century beer bottle all the artifacts appeared to date from the period 1850-1870.

Historical research to identify the Band Wreck began soon after the vessel was discovered. The Underwater Archaeology Unit shipwreck files contained the names of over eighty vessels lost in the Wilmington vicinity. From these a list of 16 steamboats was complied that were possible candidates for the Band Wreck. However, further in depth research eliminated these shipwrecks for a variety of reasons such as, wrong location, wrong type of propulsion, vessel dimensions did not correspond, or reports that the wreck has been raised.

Finally, a breakthrough in the historical research occurred when Richard Kimmel, an archaeologist with the Wilmington District Corps of Engineers, came across a passage on the steamboat *Spray* in a work by local historian James Sprunt, published in 1916. In his book Sprunt states that the *Spray* was "shaped like a barrel, hooped up on the sides." Extensive research was then conducted on the *Spray* in libraries and archives in Wilmington, North Carolina; Wilmington, Delaware; Philadelphia, Pennsylvania; and Washington, D.C., and it was found that the dimensions of the *Spray* conformed precisely with the Band Wreck down to the stroke and bore of the engines. This research revealed that the *Spray* was built in Willmington, Delaware in 1852 by Richard Gilpin at the yard of William and Albert Thatcher. The engines, built by Pusey and Jones of Wilmington, Delaware, were the ninth and tenth steam engines produced by this company that would grow to be one of the largest ship building firms on the east coast. By early 1853 the *Spray* had been brought to Wilmington, North Carolina and was in operation on the Cape Fear River. Newspaper advertisements and enrollment documents can be found for the *Spray* up to 1858 after which time there is no further mention of the vessel.

Confirmation that the Band Wreck was indeed the steamboat *Spray* came when local historian, Bill Reaves, discovered the following article from the October 23, 1891 edition of the Wilmington Star:

> "Government wrecking crew yesterday succeeded in raising the boiler and engine of the steamer SPRAY which sunk several years ago in the Northeast Cape Fear River just north of the Railroad Bridge at Hilton in the northern limits of the city."

This activity also accounts for the missing boiler and engine and the extensive damage noted at the site.

Although the wreck has been identified as the *Spray* the date and circumstances of the vessel's loss have not been discovered. It is speculated that the *Spray* was lost during the Civil War, perhaps scuttled intentionally to block the Northeast Cape Fear River channel at the fall of Wilmington in 1865. One possibility is that the *Spray* became the CSS *Caswell*, a sidewheel steamer of unknown origin and dimensions, that served in the Wilmington area. The *Caswell* was reported to have been destroyed near Wilmington, however the location of the destruction was not recorded.

At the conclusion of the project it was determined that the *Spray* site was not eligible for listing on the National Register of Historic Places. This decision was based primarily on the limited amount of intact structure remaining at the site and the wide spread destruction and removal of material during salvage activities in the 1890's. In addition the vessel was not associated with any prominent local, regional or national event or person. It was felt that the most important aspect of the site was the unique banding technique. Subsequent research has failed to locate another example of a vessel constructed in this manner. However, uniqueness or novelty is not in itself a valid criteria for significance and it was felt that the technique had been adequately documented during the site testing phase of the project. Recommendations were made for the recovery of selected items from the wreck, such as the rudder and crank shaft, should the site be threatened with destruction.

Fortunately, for the site, the coal export industry suffered a decline and plans for the American Coal Company facility have been abandoned. Currently the Underwater Archaeology Unit is exploring the possiblity of expanding the existing Wilmington National Register Historic District boundaries to include the *Spray* wreck site. For although the vessel does not qualify for the National Register on its own, it could serve as a contributing property, along with the 37 river craft remains currently included in the Wilmington Historic District.

In addition the steam engine, paddle wheel shaft and other artifacts are being prepared for inclusion in a display on steamboats to be located at the Fort Fisher State Historic Site.

RICHARD W. LAWRENCE
UNDERWATER ARCHAEOLOGY UNIT
DIVISION OF ARCHIVES AND HISTORY
P.O. BOX 58
KURE BEACH, NORTH CAROLINA 28449

J. LEE COX, JR.

Preliminary Investigation of a Revolutionary War Era Vessel in Crosswicks Creek, Bordontown, New Jersey

During March 1986, the Philadelphia Maritime Museum, in conjunction with the Pennsylvania Bureau for Historic Preservation, sponsored a project that was designed to identify and assess two shipwrecks in Crosswicks Creek, Bordentown, New Jersey. Crosswicks Creek is a tidal tributary which joins the Delaware River at Bordentown, approximately four miles below Trenton (Figure 1). Each of the wrecks are believed to be associated with a scuttled fleet of colonial warships and merchant vessels. A series of events associated with the British occupation of Philadelphia in September 1777 and the ensuing naval engagement in the Delaware River between the British naval forces and the colonial insurgents, resulted in the destruction of numerous colonial warships and merchant vessels in several of the Delaware River tributaries between Philadelphia and Trenton.

Just prior to the British occupation of Philadelphia on September 26, 1777, all valuable vessels berthed at the waterfront were taken up the Delaware River to avoid British capture. These craft were hidden and scuttled in many of the creeks above Philadelphia. The Delaware River was and is navigable and tidal as far north as Trenton - approximately thirty miles above Philadelphia and 125 miles from the Atlantic Ocean.

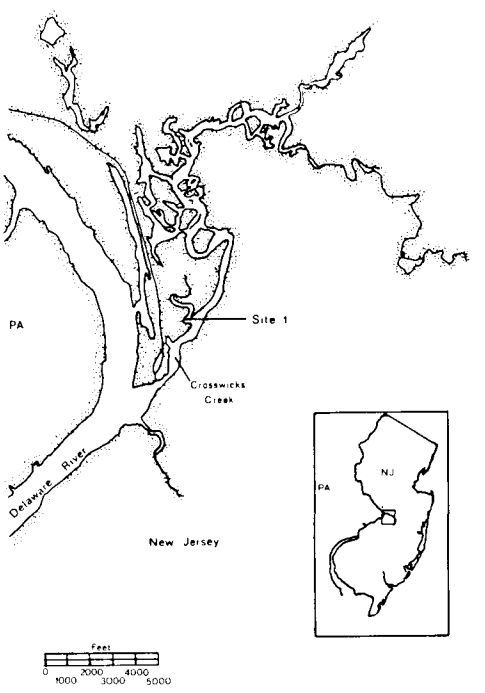


FIGURE 1. Site Map

Despite the British occupation of Philadelphia, colonial forces continued to control navigation on the Delaware River through October 1777. The colonial river defenses were comprised of a fleet of mostly small, but highly maneuverable craft, three forts below Philadelphia and a network of submerged river obstruction known as chevaux-de-frise. These defenses effectively stymied the much superior British naval forces for much of the autumn. As the river was the only major supply route for the occupying forces, the British were pressed to gain control of the Delaware River before the onset of winter closed the river to all navigation. A six week battle was waged until the outmanned colonials succumbed and evacuated Fort Mifflin during the night of November 15. The surviving colonial fleet, stationed near the mouth of Big Timber Creek, below present Camden, New Jersey, was trapped by the British Army in Philadelphia to the north and by the British warships in the Delaware River to the south.

On the nights of November 20 and 21, an attempt was undertaken to slip the trapped naval fleet past Philadelphia to join the already scuttled merchant vessels in the creeks below Trenton. Twenty-two of the smaller galleys and guard boats from the naval fleet were successfully sent past Philadelphia on the first night. However, on the second night many of the larger sailing vessels were detected by the British as they attempted to pass the city. Upon discovery, the vessels were either destroyed by the British or scuttled by the Americans to avoid capture. Colonial records indicate that a total of thirteen galleys, twelve armed boats, four sloops, two supply flats, a brig and a schooner were slipped past Philadelphia and hidden along with the merchant vessels in the upriver creeks. Furthermore, records mention that a majority of the vessels were taken to Crosswicks Creek.

Before the British chose to vacate Philadelphia in June, 1778, they planned an attack to destroy the sizable and potentially dangerous fleet of hidden colonial vessels. A seven hundred man British expedition was organized under the direction of Captain John Henry. On May 8, the expedition from Philadelphia began the onslaught by destroying two continental frigates, the unfinished *Effingham* and *Washington*, at Fieldsboro, New Jersey, just below Bordentown. From Fieldsboro, the British force continued up the Delaware River to Bordentown and Crosswicks Creek where they discovered and disabled twenty-two colonial vessels. Captain Henry reported that at Bordentown they burned brigs, schooners, sloops and privateers. A privateer, *Sturdy Beggar*, pierced for eighteen guns was the largest vessel destroyed in Crosswicks Creek.

Various nineteenth century accounts refer to the presence of "Revolutionary War Hulks" in Crosswicks Creek. E. M. Woodward in "Bordentown and It's Environs" (1876), mentions that:

> "When the British approached, two Continental galleys lying near the town were moved up Crosswicks Creek, about a half mile, and an attempt made to conceal them in Bard's Creek.... Their position was preserved by tradition and during the summer of 1875, Mr. Frederick Wiese, taking advantage of a remarkable low tide, made a thorough search for them. One was found near the mouth of the Bard's Creek...the other was found a short distance from the mouth...
>
> (Woodward, 203).

The last documented reference to the shipwrecks in the creek appears to be a brief listing in the April 22, 1910 edition of the Bordentown Register, which mentions that "some of the oldest residents still remember the old wrecks which for years lay near the entrance to Black's Creek (adjacent to the mouth of Crosswicks Creek) and were well known as the "Hulks of the Revolutionary War". However, it was not until a 1984 visual reconnaissance conducted by personnel from the Philadelphia Maritime Museum and assisted by local amateur archaeologists, that any evidence of the Revolutionary War fleet was relocated and identified. With the benefit of an unusually low tide, researchers located two wrecks in the creek that were dated to the second half of the eighteenth century. Since 1984 local enthusiasts have continued to search the creek and have located a total of six wreck sites.

The first organized survey of Crosswicks Creek was conducted by personnel from the Philadelphia Maritime Museum and Tidewater Atlantic Research in March 1986. A proposed bridge span across the mouth of Crosswicks Creek promoted fears that potential eighteenth century shipwreck sites could be impacted by construction activities. A project was conceived to fulfill two objectives: 1) conduct a systematic remote sensing survey in the bridge corridor right-of-way, and 2) evaluate and identify the condition of two of the shipwreck sites in Crosswicks Creek.

For the purpose of this publication, further discussion will be limited to the investigation of one of the two wrecks evaluated in Crosswicks Creek. Identified as Site 1, this wreck actually lies in a small tributary off Crosswicks Creek, known as Bards or Barges Creek. Researchers were initially led to the site by Woodward's reference to a well preserved wreck near the mouth of Barges Creek. Barges Creek joins Crosswicks Creek six-tenths of a mile from its confluence with the Delaware River - approximately one-half mile above Bordentown and four miles below Trenton. Barges Creek and the surrounding tidal wetlands is one of the few freshwater tidal areas along the Delaware River which has remained undeveloped. There is an approximately 6.3 foot tidal fluctuation in the Barges Creek. Depth at the wreck site typically varies from two to five feet at extreme low tide. There is a fourteen foot deep hole in a nearby downstream section of the creek. However, there have been instances where extremely dry conditions, coupled with a strong tide and favorable winds have produced a blow out tide where Site 1 becomes completely exposed. The bottom type in Barges Creek varies from a soft mud sediment to a mixture of sand and clay. Hydraulic probing indicates the presence of an historic gravel stream bed that is more than fifteen feet below the present bottom sediment.

The hull of the wreck lies roughly parallel to the west bank of the creek). A rabbeted post among the cant frames at the northeast extremity of the hull suggests that the bow lies upstream. As probing failed to reveal evidence of gudgeon straps on the rabbeted post, its identification as the stem was strengthened. Based on that identification of the stem and the orientation of the exposed structural, it appears that the vessel lists to the starboard at an angle of approximately 45 degrees and lies with its stem down by as much as 25 degrees. The stream bed has likely shifted over the years and it now appears to slightly distort the port side of the hull - which seems to hog slightly. This is more noticeable forward of an existing deck beam which appears to have provided support to the port side. Aft from the visible beam, hydraulic probing indicates the presence of decking. The decking has likely supported the stem portion of the wreck form hogging.

To facilitate the recording of the hull, a permanent baseline was established over the center axis of the wreck. While only thirty-eight feet of vessel structure is exposed above the bottom sediment, hydraulic probing generated data that suggests that the hull is at least sixty-seven feet long. initially, cross sections were probed athwartships at 19 feet and 30 feet, 9 inches aft of the stem post. Probe data confirmed that extensive structural and non-structural material survives within the hull. Although the pronounced list made precise measurement difficult, probing across the hull indicates that the beam is approximately 18 feet.

More comprehensive probing, completed by local researchers primarily under the supervision of Don Stokes, has provided significant insights into the extent of structural remains within the hull. Stokes completed probe profiles athwartships at five foot intervals back from the stempost. At the ten and fifteen foot profiles, there

does not appear to be any structural material within the hull. At 18', 6" back on the baseline, a five by eight inch vertical timber, possibly a deck stanchion, is located near the line of the keel. From this point aft, an extensive amount of structural material was detected within the hull. From the thirty foot profile aft, probing data indicates that a starboard deck remains intact. From the fifty foot interval aft, probing data suggests that most of a deck has survived across the entire profile of the wreck. At this point the interior of the hull is 15' 3" below the baseline (Figure2). This measurement was obtained when the probe apparently passed through an opening in the deck.

All exposed timbers proved to be white oak. Eight sided trunnels and hand-wrought iron spikes were used to fasten the hull and the sheathing applied to it. The stempost has a five inch wide forward face and is sided 8.3". A rabbet in the stempost is clearly visible just below the mudline. The strakes are still secured in the rabbet on the portside but the top existing strakes on the starboard side have pulled out and are evident on the bottom surface. A layer of one quarter inch pine sheathing was found fastened over a coating of pitch and animal hair applied to the exterior planking to protect the hull from marine organisms.

Frames were roughly pit sawn and/or adz shaped, with the tool marks surviving on the sided face between the bilge ceiling and exterior planking. Frames were random in size and measurements taken by Stokes indicate that most frames were sided between six and eight and one half inches and molded between five and seven inches. The futtocks were butt joined and there was no evidence of any scarf chocks. Where the sided dimension of a frame is small (less than five inches), the frames are doubled. A total of twenty-five timbers are exposed above the mud; nine of these are double frames and the first six frames are cant frames. There are several half round frames in areas where the frame spacing is nine to twelve inches - near amidships. These half round timbers, with their flat side against the exterior planking are fillings and were likely placed to provide a strong landing for chain plates. The exterior planking where not damaged, is two to two and one half inches thick and varies between ten and thirteen inches in width. Forty feet aft on the port side the exterior planking is three to three and one quarter inches thick and may be part of the wales.

No diagnostic artifacts were discovered in direct association with the hull structure. However, during previous investigations several rose head hand-wrought nails were recovered. Also, several fragments of transfer printed pearlware have been found in the vicinity of the wreck.

In conclusion, structural remains at the shipwreck site exhibit design and construction features that can reliably be considered as indicative of pre-nineteenth century workmanship. Evidence suggests that a considerable portion of the hull structure, perhaps as much as sixty five percent is preserved under the mud. The wreck was likely a sharply built vessel of approximately sixty-five to eighty tons burden. Relatively small, the vessel appears to have been built for speed. Initial evidence from the site suggests that the wreck could have been a small merchant vessel. Sheathing on the hull confirms that the vessel was at least intended for operations in southern waters where marine organisms might cause extensive hull damage.

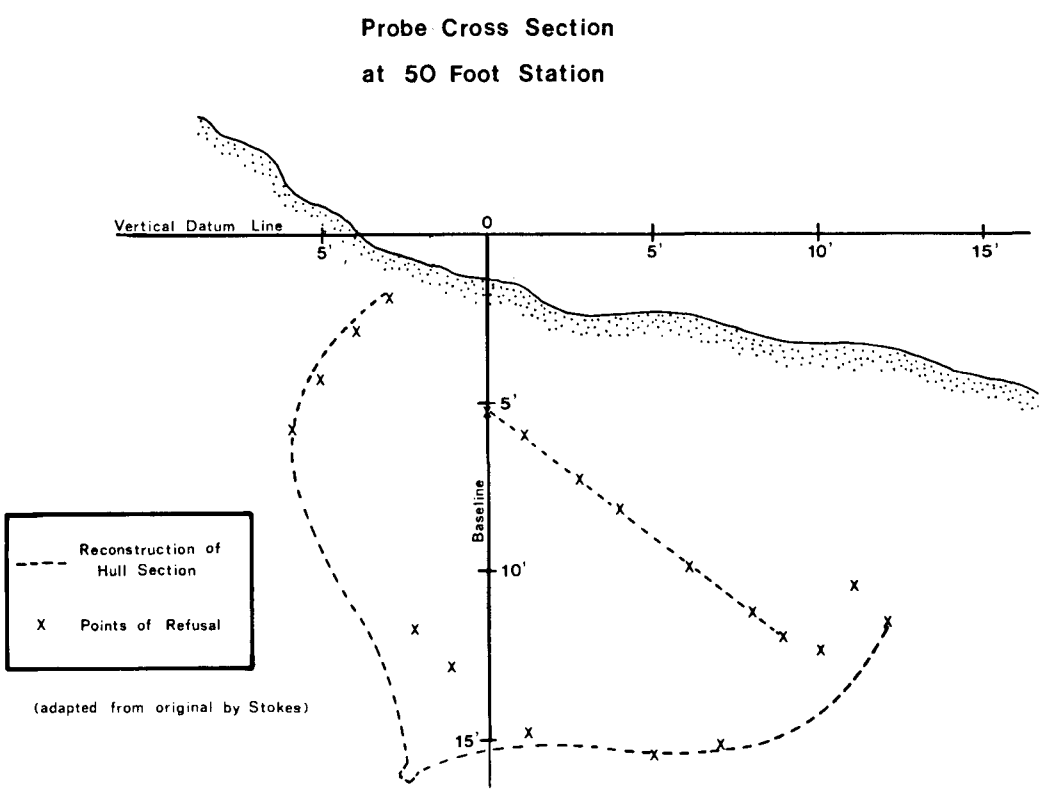


FIGURE 2. Probe cross section at 50 Foot Station

Small and lightly built, the vessel could have been rigged as a sloop, schooner or perhaps a brig. Clearly the hull would have been able to carry only limited small ordnance for protection or restricted privateering. The fact that the vessel was small and likely a commercial bottom makes the wreck highly valuable from both the historical and archaeological perspective. The site has recently been placed on the New Jersey Register of Historic Places and has been nominated for inclusion in the National Register of Historic Places.

REFERENCES

COX, J. LEE

1984 *A Preliminary Survey to Analyze the Potential Presence of Submerged Cultural Resources in the Delaware and Susquehanna Rivers.* An unpublished report submitted to the Pennsylvania Historical Commission, Harrisburg.

DOWNMAN, FRANCIS

1898 The Services of Lieut.-Colonel Francis Downman, R.A., in France, North America and the West Indies, Between the Years 1758 and 1784. *Proceedings of the Royal Artillery Institution, Vol. 25*, London.

FORD, WORTHINGTON

1894 The Defenses of Philadelphia in 1777. *Pennsylvania Magazine of History and Biography, Vol. 18*, Philadelphia.

JACKSON, JOHN

1974 *The Pennsylvania Navy, 1775-1781: The Defense of the Delaware.* Rutgers University Press, New Brunswick.

MATTEWMAN, LUKE

1878 Narrative of Lieutenant Luke Mattewman of the Revolutionary War. *Magazine of American History, Vol. 5.*

STOKES, DONALD

1986 *An Interim Report on the Bards Creek Revolutionary Era Vessel, Hamilton Twp., New Jersey,* An unpublished report submitted to the Maritime Historical Institute, Philadelphia.

WATTS, GORDON and COX, J. LEE

1986 *A Marine Cultural Resources Reconnaissance and On-Site Evaluation of Crosswicks Creek, Bordentown, New Jersey.* An unpublished report submitted to the Philadelphia Maritime Museum, Philadelphia.

WOODWARD, E. M.

1876 *Bordentown and its Environs: History.* Bordentown Historical Society.

J. LEE COX JR.
MARITIME HISTORICAL INSTITUTE
321 CHESTNUT STREET
PHILADELPHIA, PA 19106

RALPH ESHELMAN
DON SHOMETTE

On a Possible Seventeenth Century Small Craft Wreck, Lyons Creek, Calvert County, Maryland

Introduction

In 1974 Olga Schwenk hired a local farmer with dredging equipment to remove silt on the creek bottom at her boat landing along Lyons Creek, near its confluence with the Patuxent River, Calvert County, Maryland (Latitude 38 degrees 45'05", Longitude 76 degrees 14'00", U.S. Geographical Survey Topographic Map, Bristol, Maryland, Quadrangle 1957, photo revised 1970, Scale 1:24,000) (Figure 1). By use of a clam-bucket crane operated from shore, bottom sediments were removed and deposited as spoils on the immediate shoreline. Excavation reached a depth of approximately ten feet, when a solid obstruction believed to be conglomerate of the underlying Nanjemoy Formation was encountered, forcing operations to come to a halt.

After a rainstorm, the Schwenk family noticed a number of cannonballs which had eroded out of the spoil pile. The late Betty Briscoe, then curator of the Calvert County Historical Society, was contacted who in turn notified Ralph Eshelman, director of the Calvert Marine Museum. Eshelman, Briscoe, and LeRoy Langley, also of the museum, visited the site on January 9, 1975. By this time the Schwenk family had recovered a bushel basket full of cannonballs. Careful examination of the spoil area revealed kaolin pipe fragments, and framing and planking fragments from a small boat.

Eshelman took the wood fragments to Howard Hoffman, Division of Transportation, Museum of American History, Smithsonian Institution on January 10, 1975. Mr. Hoffman showed the pieces to various curators who reported more of the vessel was needed before a positive identification could be made.

Eshelman, along with a small field party consisting of Norman Riker and Evelyne Eshelman, returned to the site on March 8, 1975 with hand excavation and screening equipment. Two complete pipe bowls, green glass bottle fragments, leather shoe fragments, five more cannonballs and numerous boat fragments were recovered. Eshelman then returned with Charles "Buckie" Dowell on August 7 and 14, 1975. Using scuba gear and a water jet, the dredged area was examined to determine the extent of the site and the condition of the small craft. Additional cannonballs and planking fragments were recovered, but no intact section of the craft was encountered. This appears to have been the first use of underwater excavation equipment used to investigate a potential wreck site in the Patuxent River.

No additional work was conducted on the site until the initiation of the Patuxent River Submerged Cultural Resource Survey was undertaken by Nautical Archaeological Associates, Inc. and Calvert Marine Museum in 1978 through 1980.

Patuxent River Survey - Lyons Creek Site

During Phase II of the Patuxent River Submerged Cultural Resources Survey (see Shomette and Eshelman, 1981 and Eshelman, 1982 for a summary of this project) the Lyons Creek Site, designated 1-LCS, (the Maryland Geographical Survey, Division of Archaeology designated site number is 18 CV 253) was again examined.

Following intensive proton magnetometer survey of the creek in 1979, a hands-on field proofing of anomalies and site testing was carried out in 1979 and 1980. In an attempt to retrieve additional artifacts, a ten foot square of the spoil pile was hand excavated. In addition, a hand-held magnetometer was also used to locate ferromagnetic materials over the entire spoil area. Six additional cannonballs, a lead musket shot, numerous fragments of 17th/18th-century green bottle glass, brick fragments, nails, coal, bone, oyster shells, ceramic fragments, plus possible ballast stone were recovered.

Two additional days were spent conducting a systematic underwater examination of the site. The entire waterfront was first probed with an iron rod with little success. A water jet probe made several "hits" but none could satisfactorily be evaluated due to their depth and continual collapse of the probe hole. A small underwater dredge was employed but it quickly became clogged with sediment. Systematic probing with the water jet along a line marked A on figure 2 was then carried out. Three test pits approximately three feet deep were excavated with the water jet at location "1" and "2" where "hits" were made. Two cannonballs (1-LC-43-44) encrusted together were found in pit "1" and one in pit "2". Numerous brick and possible ballast stone were also recovered. No artifacts were found in test pit "3". Several small pieces of worked wood were recovered in test pit "2". Stratigraphic site integrity was next to impossible due to the fluid nature of the mud matrix, constant collapse of the test pit wall, and zero visibility.

A second probe line marked B on figure 2 was probed by water jet with no positive results. Test pit "4" and "5" revealed nothing more than a log. By excavating a trench toward shore, several wooden planks and other assorted small wood fragments were encountered at position "6". Test pit "7" proved negative and was followed by water jet probing along line "C," also without positive results. Finally, test pits "1" and "2" were reexamined with the dredge, and again, brick and presumed ballast stone were recovered.

These efforts were largely inconclusive concerning the presence or absence or a sunken vessel at the Lyons Creek Site. Whether the major portion of the vessel was destroyed by the clam bucket operation or whether a major diagnostic portion of the wreck is still extant, is undetermined at this time. In order to excavate below the three foot level, a coffer dam would have been necessary to hold back the almost fluid mud bottom. However, use of this device by that time was not possible as all funds and manpower were being directed toward the Turtle Shell wreck excavation, the remains of a largely intact Chesapeake Flotilla warship dating from the War of 1812. (See Shomette 1981 and Hopkins and Shomette 1981 for details.

Artifacts

The description of artifacts below is not intended to be a detailed analysis, but merely a summary of the material with an attempt to determine an age for the site.

Cannonballs - Dr. Charles R. Fisher of the University of Baltimore, a naval historian and expert on 17th/19th-century ordnance examined and measured the cannonballs. Fisher noted (personal correspondance) that their probable service was intended for artillery of English manufacture. Though most Western European nations and the United States produced standard artillery for the same weight of ball, the actual bore size of artillery pieces and the calibre of ball employed as ammunition varied slightly with each nation. During the period of the American Revolution, when casting had reached a high degree of sophistication, Muller (1780) cited that the diameter (English measure) of a French 9-pound shot was 4.188 inches while the diameter of an English 9-pounder was 4 inches. Fisher compared relative diameters of American, English, French, and Spanish cannonballs with the average diameter of the best-preserved cannonballs from the Lyons Creek Site and determined that they had probably

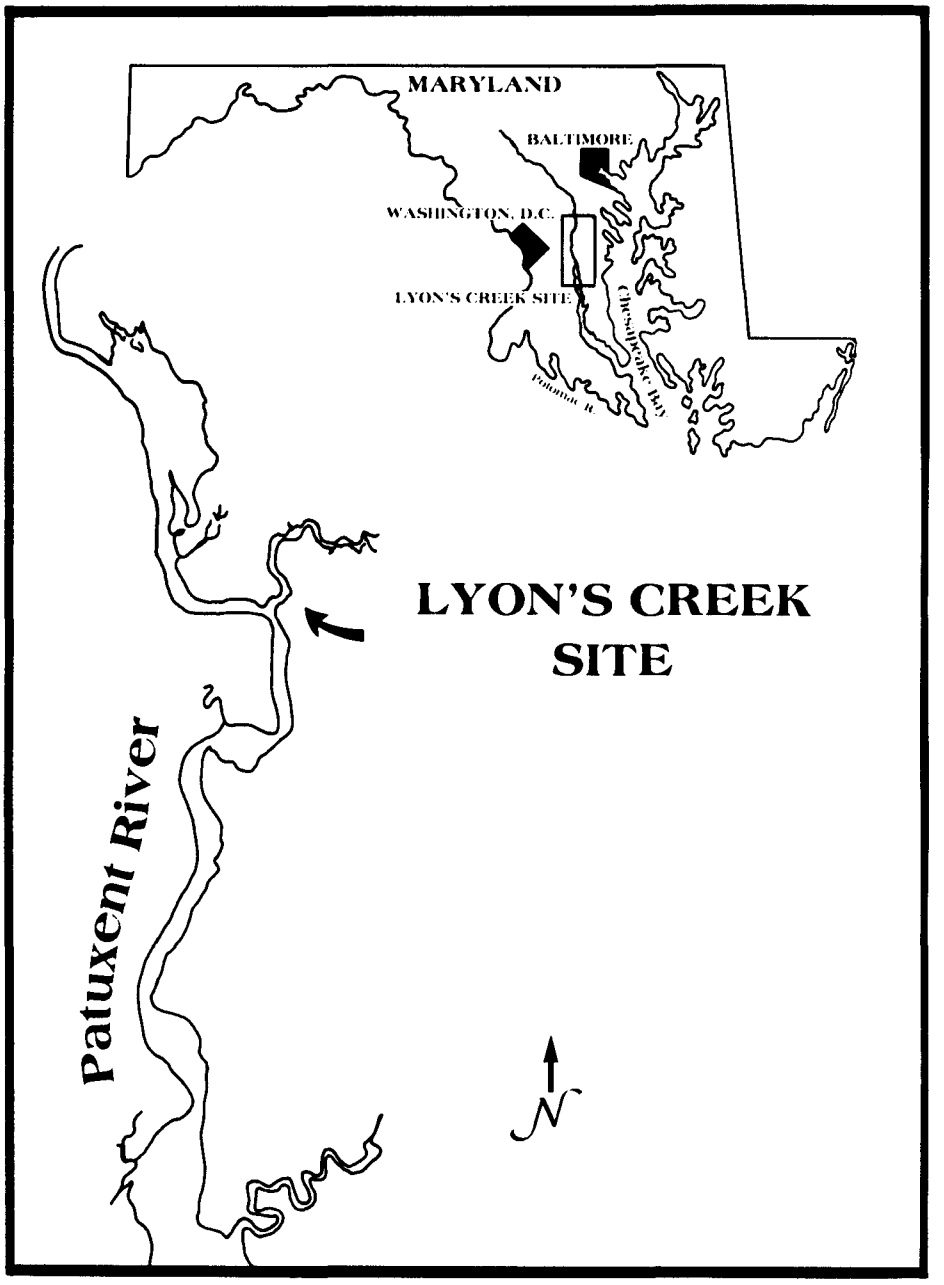


FIGURE 1. Map showing location of Lyons Creek Site, Calvert County, Maryland.

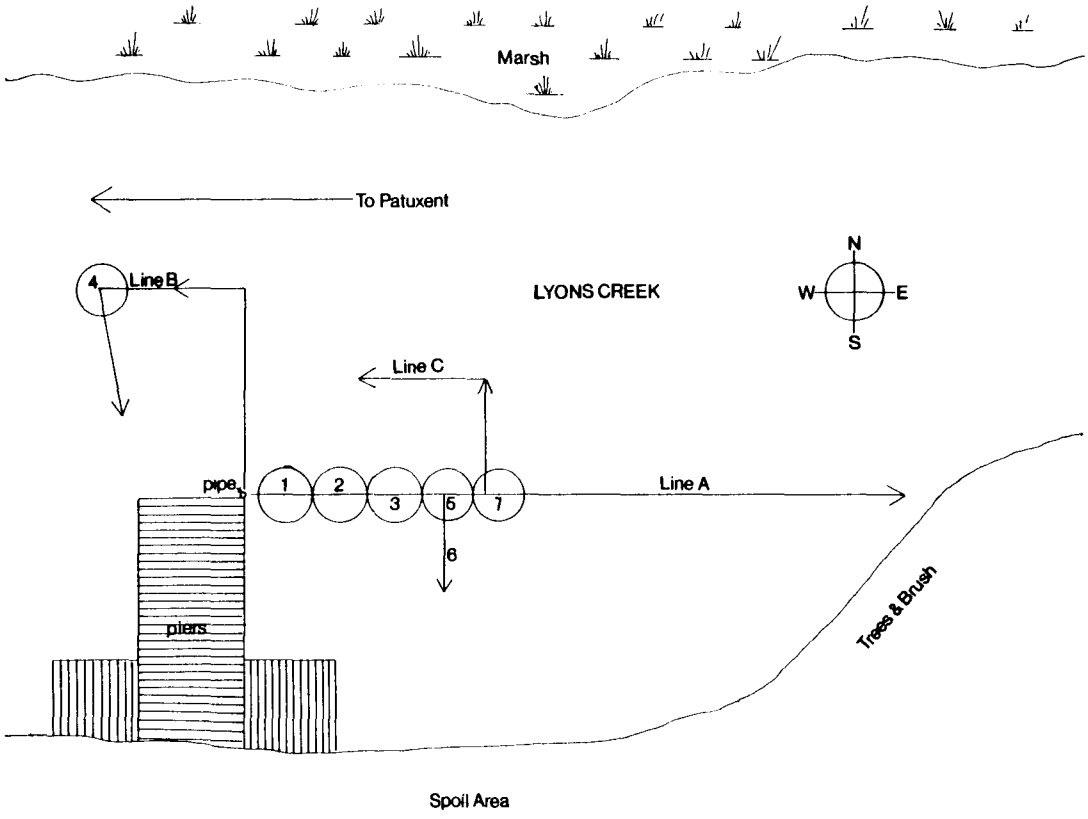


FIGURE 2. Diagram of Lyons Creek Site showing test pit excavations carried out during the Patuxent Submerged Cultural Resource Survey.

been intended for use in English artillery.

With the help of the Metallurgical Division of Bethlehem Steel Corporation, Sparrows Point, Maryland, a metallographic and chemical analysis of two cannonballs recovered from the spoil pile at the Lyons Creek Site was carried out. As a precaution, the projectiles were first X-rayed to determine whether or not they were bombs or solid shot and as expected were found to be solid shot. Several of the projectiles were then cut into sections and others were cored by diamond drills. The sections were then submitted to examination through photomicrography. Microhardness tests were then performed on a Tukon Hardness Tester. Macrohardness was also measured on a Rockwell hardness tester.

While the date of the origin of the cannonballs could not be determined, the large percentage of phosphorous (1.3% of weight), and hence steadite, ruled out modern casting. According to Chief Metallurgist M.B. Shelly, the cannonballs were of unusual hardness, as evidenced by high percentages of steadite and pearlite. Iron which has been produced by contemporary foundry processes contain an insignificant percentage of both pearlite and steadite. Therefore, the hardness of modern iron is occasionally far less than that produced by primitive foundry work, although uniformity is superior. Shelly (personal correspondance) noted that, although no experimentation had been carried out which related the increased percentage of trace elements such as steadite to a given time frame, iron produced under less sophisticated conditions, such as in the backyard furnaces of China of the 1950s-1960s period, generally possessed considerably greater percentages of the element.

Forty-five cannonballs were recovered and analyzed from the Lyons Creek Site, most of which were excavated from the spoil pile. The museum has thirty-nine cannonballs in its collection (CMM 75.425.27-65), and Mr. Schwenk four, and two balls were destroyed for chemical analysis. It was impossible to examine the bore diameters with total accuracy until after they had undergone electrolytic reduction at the Calvert Marine Museum's conservation laboratory to remove the heavy conglomerates on the exterior surface. After conservation, measurements were taken and each projectile was weighed. These figures indicate that bore diameter and weight of ball are inconsistent. This may result from the unsophisticated manner in

which the items were produced, as well as the effects of continued submersion and the consequent corrosion and reduction of surface areas.

Nevertheless, it is clear that at least five different calibres of cannonballs were recovered. As cannonballs are commonly listed by weight, even though calibre weight traditionally bore little accurate relationship to the actual weight, they will be noted by the latter. By our calculations there are three 24-pounders, eighteen 18-pounders, seven 10 or 12-pounders, fifteen 8-pounders, and two 6-pounders. These are estimates as corrosion has altered ball diameter and weights.

It is not possible to ascribe a time frame based upon dimensions and weight alone. It is not even possible to attribute the presence of the munitions to a military purpose, since both out-of-service artillery and heavy solid shot munitions were known to have been widely used as ballast in sailing vessels from the early colonial period well into the 19th century (Marx 1971).

Kaolin pipes - Fifty-five kaolin pipe fragments, including several intact bowls, twenty-eight with measurable pipe stem bores, were recovered. Using the Binford straight-line regression formula, based upon the Harrington dating theory (Hume 1972; Harrington 1954), which achieves a time frame based upon pipe stem aperature diameters and upon traditional dating of bowl forms, a bracketing date of 1680s-1730s with a suggested deposition date of 1690. However, this time frame must be considered tentative due to the small sample. The bowl fragments are well-preserved with the following undated or attributable marks: "BN"?, "SI", "W", and "?W".

Ceramics - At least eleven and possibly fourteen different ceramic types are represented by seventy-four fragments. Only the more diagnostic pieces are discussed below.

One gravel-tempered, body sherd (18 CV 253-5) from North Devon dates anywhere between ca. 1610 and 1750 (personal correspondance Hume to Eshelman, November 15, 1985).

Twenty-five sherds (18 CV 253.4) of yellow lead-glazed earthenware represent fragments from one milk pan of European type, possibly French or Flemish. The pan is glazed inside and out; has no decorations, the rim is shaped with what Noel Hume describes as a "hammerhead pan" rim with two horizontal loop handles attached to the rim. The pan has a hard vitreous off-white, slightly pinkish body with occasional ocher and quartz inclusions. Ceramics of this type are known from the seventeenth and eighteenth centuries in Europe. Sherds of a similar but not identical ware have been recovered from the Kings Reach Site in Calvert County in a ca. 1690-1715 context (personal communication with Dennis Pogue).

Twenty polychrome decorated tin glazed earthen ware sherds (18 CV 253.1) representing a plate of probably Bristol origin date to around 1715 to 1730 (personal correspondence Hume to Eshelman November 15, 1985). The design is floral in blue, red, and green colors.

Three tin glazed earthen ware sherds (18 CV 253.2) all decorated with blue floral patterns represent one bowl base, a plate rim, and punch bowl body. Two lead glazed earthenware sherds (18 CV 253.14) are slip-decorated in a sgraffito design, possibly a crown. This piece is "Germanic in character and, if made in America, would most likely date from the second half of the century. On the other hand, if they are indeed of German or Rhenish origin, then they may, perhaps, be earlier. It is certainly interesting that there are two vessels of the same character, but with an entirely different decoration" (personal correspondance Hume to Eshelman November 15, 1985). For a more complete description of the ceramics see Pogue's catalogue sheets for the Lyons Creek Site, dated 5-1-86, on file at Jefferson Patterson Park and Museum.

Bottles - Sixty -six green wine bottles fragments (18 CV 253.20-27) recovered from the spoil pile also reinforce the 1680-1730 time frame ascribed to the site. Three nearly complete base sections and two intact neck sections, were recovered, along with a wide assortment of miscellaneous body fragments. The largest and most heavy base fragment (18 CV 253.24) has a low broad kick with rounded sides. Noel Hume dates this base around 1675-1680. Base fragment (18 CV 253.23) has vertical incurving sides and a pontil mark. Hume dates this fragment around 1725 or 1730. One neck fragment (18 CV 253.21), was found with the wire closer still attached around the neck immediately below the applied string rim.

Miscellaneous Metal Objects - A small copper pot was recovered from the spoil pile in a battered and bent condition, but is otherwise well-preserved. Three holes on each side indicate that a handle of some sort was once attached.

Two fragments of a wrought-iron key were recovered in a poor state of preservation. An assortment of five wrought-iron nails and spikes were recovered; one of which looks as if it may be cut though the poor state of preservation prevents positive identification. One iron knife blade fragment was severed but no cutler's mark can be seen. One lead shot of 17mm diameter is unusual in that it appears to be an imperfectly made shot, probably from incomplete filling of the mold.

Leather - Six leather pieces which appear to be parts of a single built up shoe heel were also recovered. Uniform nail holes are visible around the periphery of the semicircular shaped leather pieces, one contains three small nails or tacks.

Bones - Remains of vertebrates include a pig (Sus scrofa), canine and deer (Odocoileus virginianus) metapodial.

Miscellaneous - Numerous fragments of brick as well as several smooth cobbles possibly use as ballast were noted in the spoil pile. The presence of coal fragments however argue that the brick may have been part of a deck camboose or purely house refuge. Also recovered were four gray flint chunks, at least two show evidence of being worked.

Small craft remains - A total of 26 frame, plank, and molding sections (CMM 75.425.1-26) of a small wooden vessel were recovered. The majority of these were recovered from the spoil pile, although several pieces were retrieved by divers during the underwater investigation of the site in 1975 and 1980.

Though fragmentary and without any of its assemblage integrity intact, the boat sections recovered provide some information concerning the architecture of the vessel itself. The planks were cut with a pitsaw, saw marks of which are still visible on several planks. The treenails were hand-shaped not lathe made to fit holes bored through framing members. It appears a spoke shave or similar tool was used to roughly round the treenail; a random rather than identical sided pattern is evident. The builders apparently were content to rely upon the natural swelling of the wood to prohibit the fitting from coming loose, rather than to drive a wedge into the treenail after its insertion into the treenail hole—an act which was normally carried out in boat construction. However, there were no wedges in the juniper and hickory trunnels of the 18th century Ronson Ship discovered in Manhattan, New York in 1982, though a few of the trunnels had square nails driven into the ends of the trunnels (Dean 1985).

Several framing members were recovered and indicate that the vessel was of clinker or lapstrake construction, that is the lower edge of an upper plank overlaps outside the upper edge of a lower plank. This tradition achieved its earliest and greatest development in Saxon and Viking ships and soon became a widespread tradition which spread to Britain, Northern Europe, and later North America (Greenhill, 1976). From the representative planking recovered and

the shallow depth of the stepped incisions, it would appear that the craft was lightly and crudely constructed. Both rose-headed nails and treenails held the planking to the frame, while the overlapping planks of the hull were affixed with nails. A few planks possess what appear to have been square washer-like metal pieces placed between the plank and the fastener. Both a sample of planking and framing from the wreck were submitted to the Forest Products Laboratory at Madison, Wisconsin. Donna J. Christensen identified the samples as oak (Quercus sp.) of the white oak group (letter to Eshelman, Dec. 21, 1977). From the size of the planking and framing pieces a small craft of approximately 16 to 22 feet is suggested, possibly a ship's boat. The moulding pieces may or may not belong to the small craft.

Discussion

It is impossible to state that the ceramics, bottles, shoe, key, copper pot, and other artifacts recovered from the spoil piles and adjacent waters at the Lyons Creek Site are contemporary with the wooden boat fragments recovered from these same places. For example, it is possible the wreck site is located at a former boat landing or dump site where cultural materials from two or more discrete sites or time units have become mixed by the dredging operation. No measurable stratigraphic profile was possible due to the disturbance to the site during dredging (to depths of ten feet below the creek bottom), the fluidness of the matrix, and the black water (up to five feet deep) conditions. The methodology employed in the evaluation of the site was neither comprehensive nor thorough enough to provide more than corollary data on the site as an archaeological unit. The artifacts as a totality, suggest a period of deposition ca. 1680-1730. If they are, in fact, chronologically contiguous to that of the vessel, the remains of the small craft from the Lyons Creek Site may represent the oldest small-boat wreck of Euro-American manufacture yet located in the United States. Even if the vessel is not contiguous to the conjectured 1680-1730 time frame, it certainly predates 1840, after which time the employment of pit saws by boatwrights generally ceased and the utilization of steam-powered sawmills began (Chapelle, 1960: 18).

If the artifacts and the boat were sunk at the same time as a single event, the craft might have served as a military lighter, carrying munitions across the Patuxent River, perhaps to or from Mount Calvert or the strategic heights at Lyons Creek for some undetermined purpose. The presence of cannonballs and a musket ball suggest the possible military nature of the vessel. The copper pot, ceramics, brick, and coal could argue that the vessel was lived upon. Wine bottles would have also been present. Wine bottles, in fact, were among the few diagnostic articles discovered on the Brown's Ferry Wreck (also a small-craft wreck, ca. 1733), discovered under similar conditions in South Carolina (Albright, personal communication). This, however, is a rather small vessel for such an array of material to be found.

The only major military event which occurred along the Patuxent River drainage during the 1680-1730 period was the Revolution of 1689. At that time a call for arms and munitions went out from both Catholic and Protestant forces. Catholic forces, besieged at Mattapany located on the mouth of the Patuxent River in St. Mary's County, eventually succumbed to superior Protestant troops, and the revolution came to an end (Carr and Jordan, 1974).

One vessel has been documented as having been lost in the Patuxent ca. 1680-1730. That vessel called the Richard and *Mary* was a pink belonging to Captain George Harris lost in 1707. Harris owned and operated a store at Charles Town, just up river from Nottingham. However, since Harris also owned 100 acres in Calvert County (though its location is unknown), a tract called Illingworth Fortune (Inventory and Accounts; Archives, XXXVIII: 281-283; Wills, VIII: 1), and since the date of loss of his vessel falls within the conjectured time frame of the Lyons Creek Site, the possibility that the two vessels are one in the same is an interesting possibility. Harris was refunded 30£ for the loss of his pink in the river by the colony government, though the service his vessel was performing is unknown. Could it have been serving as a military lighter? Conversely, if our estimate of boat length is correct, the Lyons Creek wreck is too small to be a pink.

Unfortunately, until further intensive evaluation of the underwater site is carried out, no definitive prognosis of date or origin can be safely ventured. The artifactual materials deposited in Lyons Creek may only be domestic and military refuse deposited in the river from the shore on a site at which either before, during or after the 1680-1730 period a small boat came to rest. Access to the water's edge here from the upland is facilitated by a convenient ravine which terminates there. It seems likely, however, that individuals occupying the upland would have simply cast their refuse over the sides of the steep cliffs rather than carry such materials down to the water's edge, as deposition at the site would have required.

The site would have provided an excellent landing for small boats and could have conceivably served as the terminus for the ferry operation between Mount Calvert and Lyons Creek or docking area during storms or ice. However, it is likely that the ferry operation itself was located on the more convenient, though exposed, river front, where the Lyons Creek steamboat landing was later erected. By 1673 a private ferry operated across the Patuxent River with its main terminus situated somewhere near the mouth of Lyons Creek (Shomette 1979: 29). Shomette (1978: 45) refers to "the Pigg's Point ferry at Lyons Creek."

Peter Schwenk has donated to the Calvert Marine Museum 41 cannonballs representing at least five calibres, all the framing and planking pieces of the wreck and a small synoptic collection of ceramics, glass and pipe stems. These artifacts are deposited in the museum collection.

All the wood fragments were treated with polyethylene glycol and the cannonballs were conserved by undergoing electrolytic reduction at the Calvert Marine Museum's modest conservation laboratory. Because the wood fragments were exposed for weeks before collection was possible, some shrinkage and distortion is present.

Conclusion - It might be stated that the potential of the Lyons Creek Site for providing additional data is considerable, though wrought with many pitfalls. Because the site has been disturbed by dredging, it is possible that its integrity has been destroyed to such an extent that little more than simple artifact collecting can be carried out. However, should some semblence of the site remain and even a vestige of stratigraphic integrity be discerned, a comprehensive coffer dam excavation would probably yield an enormous amount of information, particularly relating to early Euro-American and Tidewater boat construction—an area in which there is now a dearth of information. It is our opinion that the bulk of or all of the artifacts recovered from the site are not directly associated with the small craft wreck. Noel Hume (personal correspondance to Eshelman November 15, 1985) states that, "I see it [the collection] covering a 50-year span and being a curious mixture of English and European sherds. I should add that the bottles are all English as are the pipes. If you were to tell me that the material came from a fifty-year old ship that had traded with northern European ports before sinking in 1730, I should not be surprised. On the other hand, it does seem to be a rather improbable assemblage, and really is more likely to be the product of domestic discarding, albeit from a household with perhaps Huguenot

connections." Ironically, if the small craft wreck is contemporaneous with the deposition of the recovered artifacts, this may represent on of those rare instances when a shipwreck has been dated by the aid of non-directly associated cultural material with which it was buried. The site minus the wreck is an important assemblage of cultural material from one of the earliest European occupation sites along the Patuxent River. Fred Hocker, Nautical Archaeology, Texas A&M University, is presently studying the small craft remains. If warranted, a further report may follow this preliminary report.

Acknowledgments

Special appreciation is extended to Peter Schwenk who encouraged our participation and allowed access to their family property to engage in this study. Mrs. Olga Schwenk made our visit most hospitable. Recognition must also be made of Dr. John Sands, Division of Collections at Colonial Williamsburg, who was the first to realize the importance of the site, suggesting an early 18th-century date. Funding in part was made possible by a grant from the Heritage, Conservation, and Recreation Service of the United States Department of Interior, administered by the Maryland Historical Trust.

David Bohaska, CMM registrar, and Dennis Pogue, Jefferson Patterson Park and Museum, made the measurements on the pipe stem aperatures. Leslie Bright, conservator, North Carolina Division of Archives and History, Evelyne Eshelman, chemist at Baltimore Gas and Electric Company, Pogue, and Bohaska did the conservation of the collection. Norm Riker built the screening equipment used for the terrestrial excavation portions of the site. E.B. Shelly, Chief Metallurgist of Bethlehem Steel Corporation Sparrows Point, Maryland, and Dr. Charles R. Fisher, University of Baltimore, and Dr. Fred Hopkins, Dean of the Graduate School, University of Baltimore, researched and performed the metallographic studies of the cannonballs. I. Noel Hume, Resident Archaeologist, The Colonial Williamsburg Foundation, and Dennis Pogue, Archaeologist, Southern Maryland Regional Archaeological Center for the Maryland Historical Trust, located at Jefferson Patterson Park and Museum, were most helpful in identification of artifacts and sharing their knowledge on age assessment of the collection. Appreciation is extended to the following who helped in the field aspects of the project: Evelyne Eshelman, Charles Dowell, Norman Riker, Eldon Volkmer, Ken Hollingshead, John Burton, Fred Hopkins, Peter Schwenk, and Nicholas Freda.

REFERENCES

ARCHIVES OF MARYLAND
1883 Maryland Historical Society. Baltimore, Maryland.

CARR, L.G. AND JORDAN, D.W.
1974 *Maryland's Revolution of Government, 1689-1692*. Cornell University Press. Ithaca, New York and London, England.

CHAPELLE, H.I.
1960 *The American Watercraft Collection*. Smithsonian Institution, Washington, D.C.

DEAN, NICKOLAS
1985 *Manhattan Mystery Merchant Ship: Her Discovery Today*. Wooden Boat, No. 63, pp. 96-100.

ESHELMAN, R.E.
1982 *The Patuxent River Project, 3 Centuries of Maryland Architecture*: A selection of presentations made at the 11th annual conference of the Maryland Historic Trust, pp 58-62.

GREENHILL, BASIL
1976 *Archaeology of the Boat*. Wesleyan University Press. Middleton, Connecticut.

HARRINGTON, J.C.
1954 *Dating stem fragments of seventeenth and eighteenth century clay tobacco pipes*. Quarterly Bulletin of the Archaeological Society of Virginia, vol. 9, no. 1.

HOPKINS, F.W., JR. AND SHOMETTE, D.G.
1981 *War on the Patuxent 1814: A catalog of artifacts*. Nautical Archaeological Associates, Inc. and Calvert Marine Museum Press, Solomons, Maryland, p 44.

HUME, IVOR NOEL
1972 *Artifacts of Colonial America*. Alfred A. Knopf, New York, NY.

MARX, ROBERT F.
1971 *Shipwrecks of the Western Hemisphere 1492-1825*. The World Publishing Company, New York, NY.

MULLER, JOHN
1780 *A Treatise on Artillery*. John Millan, London, England.

SHOMETTE, D.G.
1978 *Londontown: A Brief History*. London Town Publik House Commission, Inc., Londontown, Maryland, p 84.

SHOMETTE, D.G.
1979 *The Patuxent River Submerged Cultural Resource Survey: Historic Overview*. Unpublished MS on file at Calvert Marine Museum, p 463.

SHOMETTE, D.G.
1981 *Flotilla: Battle for the Patuxent*. Calvert Marine Museum Press, Solomons, Maryland, p 257.

SHOMETTE, D.G. AND ESHELMAN, R.E.
1981 *The Patuxent River Submerged Cultural Resource Survey: Drum Point to Queen Anne's Bridge, Maryland*. Maryland Historical Trust Manuscript Series No. 13, p 698.

RALPH ESHELMAN
CALVERT MARINE MUSEUM
SOLOMONS ISLAND, MARYLAND 20688

DON SHOMETTE
NAUTICAL ARCHAEOLOGICAL ASSOCIATES
9 110 GRAND HAVEN AVENUE
UPPER MALBORO, MARYLAND 20772

JOHN D. BROADWATER

The Yorktown Shipwreck Archaeological Project: Results from the 1986 Season

Introduction

In the summer of 1781, General Charles Cornwallis moved his Southern British Army to Yorktown, Virginia, along with a fleet of some 60 ships, most of which were transport vessels. Blockaded at Yorktown by a much superior French fleet, Cornwallis was subjected to siege during which his ships were either scuttled or sunk by allied cannon fire. On October 19, 1781, he surrendered the army, thus ending the last major battle of the American Revolution. Although some salvage occurred that winter, records indicate that 26 major vessels are unaccounted for and presumed to remain on the bottom of the York River. (The history of Cornwallis' fleet has been reported in detail in previous conference proceedings and is thoroughly documented in Sands 1983).

The Yorktown Shipwreck Archaeological Project, a full-time research project of the Virginia Division of Historic Landmarks, has located nine of these ships, including the ship currently under study, known by its site name, 44YO88. The excavation is being conducted from within a steel enclosure, or cofferdam; the enclosed water is being clarified by commercial filters to help offset adverse site conditions.

Site facilities were badly damaged in November, 1985, during Hurricane Juan, but repairs and improvements were made, with the following milestones: repairs to the work platform were made by Newport News Shipbuilding and others, and a second platform was added; a new, stronger liner, donated by Phillips Fibers Inc., was installed to slow seepage of river water; airlifts were rebuilt and a new compressor, which allows three or more airlifts to be operated simultaneously, was donated by Bauer Compressors; Ecolochem Corp. provided continued assistance, first helping repair the filters and then overseeing filtration operations. Water clarification efforts were extremely successful, with average visibility exceeding that of all previous seasons.

Project methodology has been reported previously, but the following is a brief description of general methods as well as improvements initiated during 1986: large areas were excavated simultaneously, using a PVC grid as a scaffold and horizontal control guide. The grid was also used as a reference for vertical control, but level lines were used as a double-check for vertical measurements; all key measurements to artifacts and hull components were made using a three-dimensional system, with control points attached to surveyed hooks on the cofferdam walls; measurements were converted by computer to rectilinear coordinates; scale drawings were made of large areas, to show associations, supplemented by more detailed drawings, photographs, and 3-D measurements; new top-side checklists were initiated to minimize the possibility of inadvertent data loss.

National Geographic Society photographer Bates Littlehales continued to work with the project this year to document the excavation. East Carolina University participated in the project once again through the fall research semester of the Program in Maritime History and Underwater Research.

Excavation

Progress was good in 1986, despite delays in competing repairs at the site. During much of the season, excavation was conducted simultaneously in the bow and stern. In the bow, all contents were removed to approximately 14 feet aft of the forward bulkhead; in the stern, all material was excavated aft of the after bulkhead, and progress was made forward of that bulkhead; a trench was excavated along the entire port side to help define ballast and cargo.

Careful attention was paid to stratigraphy, and several profiles were cleaned, drawn, and photographed in detail. Soil samples were taken from each defined strata in these profiles and will be analyzed this spring.

Bow: Excavation in the bow revealed numerous intact casks, including two large upright ones just aft of the forward bulkhead. These casks were the only ones confirmed to be in situ. They were set approximately 18 inches into the sand ballast, on either side of the keelson. Samples were taken of grain and other organic materials in the bottoms of the casks. Again, samples were taken for analysis. Numerous artifacts were found lying directly on the surface of the sand layer, confirming that the sand was in the hold of the ship when it sank.

Figure 1 is a sketch by Kevin Crisman of the area just aft of the forward bulkhead, looking forward. One of the most unusual finds of the season was a deteriorating two-inch-thick pine deck plank that had collapsed onto the starboard upright cask where it was penetrated by the staves (arrow, Figure 1). Also seen in Figure 1 is an intact cask with "32/2" cut into the head, and the shaft and blade from a sweep, used to propel the ship.

Stern: Excavation in the stern was completed aft of the aftermost bulkhead, where intact wine bottles, a small cask, numerous furniture fragments and other objects were located. The remaining bulkhead planks were removed, and excavation continued forward, where additional timbers, wine bottles and an intact door were encountered.

Hull Measurements: Measurement reference lines were installed across the hull, perpendicular to the line of the keel, at pre-determined stations and the end points of each line were located precisely with the 3-D measurement system. From these lines, a weighted tape measure was used to measure vertical distances along the lines to the inside of the ceiling planking. In this manner, five sets of hull cross-sectional lines were taken off in the bow, and an additional two sets in the stern.

Results/Analysis

This year the project acquired the use of an extremely powerful analytical tool, a computer-aided design (or CAD) system. Advanced Marine Enterprises, Inc. of Virginia Beach, offered to assist with the analysis and recording of hull data using a Prime computer and an interactive software package called Medusa. Field data were entered for each station, then best-fit curves were generated, with the curves controlled by the operator to conform to the measured points. It should be emphasized here that the CAD system is not being used merely as a high-tech drafting machine; rather it has become a powerful tool for analyzing the site, both hull and contents. (In all fairness to the CAD, however, it would be difficult to find a better means of producing a technical drawing!). As an example, by using the program's interactive powers, we were able to easily check for symmetry, angle of heel, probable measurement errors, etc. This analysis verified that YO88 is lying on an even keel. Also, the CAD can store hull and artifact assemblages in separate layers, or data sets, which can be recalled in any combination.

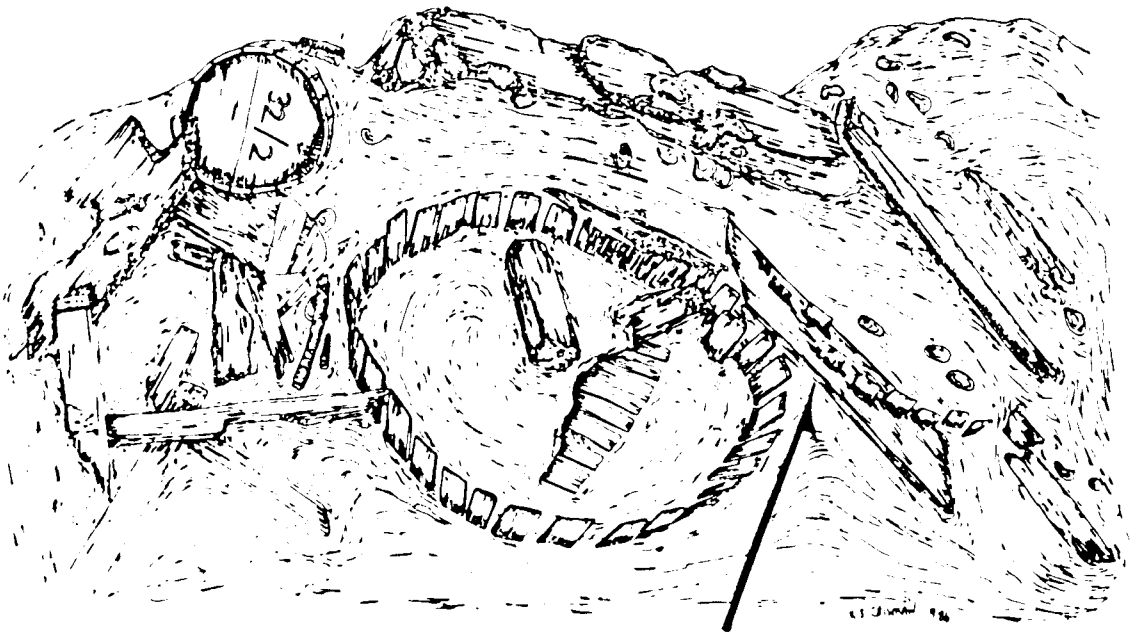


FIGURE 1. Sketch of area just aft of foremast, facing forward. Arrow indicates staves penetrating a deck plank. (Sketch by Kevin Crisman)

Since all data has not been entered into the computer, a preliminary body plan was drawn by hand to illustrate the results so far. Although these lines are taken to the inside of the ceiling planking, not the outside frame faces, these preliminary lines clearly show that the ship is very full-bodied and bluff-bowed.

A major source of errors in taking off lines is the orientation of the hull: yaw, pitch and roll must all be taken into account. Of these, pitch can cause the most trouble, since it can be difficult to determine whether the ship is bow- or stern-down. A single pitch angle can cause field measurements to be too high, too low or correct, depending upon where the measurment is taken, which causes variable distortions of the resulting lines. The CAD system can simplify correction of these distortions.

Ceiling and fastening details were traced one-to-one on large sheets of plastic. These tracings were then transferred to scale drawings for analysis and model-building. Wood samples were taken from several timbers and numerous interior fragments and these are being analyzed. Several specialists are involved in other analysis including, cooperage, organic samples, ballast, furniture, textiles and shoes.

Hull: the keelson and its riders are unusual. The foremast is stepped on a rider, which emerges from the ceiling planking in the bow. This first rider is scarphed into a thinner rider approximately six feet aft of the mast step. The forward rider, which is 14 inches wide, is slightly offset to port on the keelson, which is approximately 16 inches wide.

The bow is very full, with a solid ceiling Horizontal apron pieces bolt to the stempost. The stern mirrors the unusual bow construction: the ceiling is solid, almost meeting at the stern and concealing stern deadwood.

The position of the lower deck provided just over seven feet of depth in hold, amidships, and the deck may have stepped down a foot or so in the stern cabin area. It was constructed of beams at least 7 x 7 inches and soft pine planks just under 2-1/2 inches thick.

No deck remains were found forward of the forward bulkhead, suggesting the area may have been an open cable locker. Curiously, no deck stanchions or steps have been found aft of the bulkhead, but planking from both decks has survived, as we have beams and knees further aft.

Parts of what appear to be a hatch cover were located near the starboard side, aft of the foremast, along with what may be a side beam for the main hatch. Thus, a large hatch was probably located between the masts.

An object believed to be the remains of the windlass was found just aft of the foremast on the starboard side. This object is too heavily encrusted to permit quick analysis, but it will be x-rayed and carefully cleaned for study as soon as lab space permits.

The remains of a large sweep, with a preserved blade length of 5-1/2 feet was located in the bow. Its size indicates that it was used to propel the ship, not a ship's boat.

Ballast: The ship was ballasted with sand to a depth of 2-3 feet. The sand contains a high percentage of gravel with a few larger rocks. A preliminary analysis of the ballast by Dr. Gerald Johnson, Department of Geology, College of William and Mary, reveals: The sand is quartz-rich, with disseminated mica; the gravel and stone represent a very diverse assemblage, not likely to be from one locality; the sand

and stone are definitely not from the York River; although analysis has just begun, samples suggest a British origin.

Numerous artifacts were found lying directly on top of the sand layer. The sand, itself, was relatively artifact-free. Additional artifacts were encountered near the ceiling, and these were probably deposited at an earlier period.

Cooperage: Because of the numerous and varied casks recovered to date, and thanks to the enthusiastic and skilled assistance of cooper Kerry Shackelford of the Colonial Williamsburg Foundation, this is one of the most thorough studies of 18th century cooperage ever conducted. Much is still being learned about such factors as construction, repairs, markings, etc. To date, a total of 32 intact or partially-intact casks and buckets have been recovered, and several hundred additional loose staves and head pieces account for additional casks.

The two large, upright casks are particularly interesting: the two are virtually identical and were likely made by the same cooper. They measure 42 inches length x 36 inches diameter. Both are slack casks (made for dry goods); the staves are rough-split (not trimmed); both had 2-3 hoops in the middle and at the ends; both had liner (inside) hoops at ends. Liner hoops were important; one complaint about casks being shipped to America was that "...a great quantity of flour whole barrels are lost" (Syrett 1970:142).

These casks also exhibit the first positive evidence of nailed hoops: of the 39 staves in cask CA525, one end had 51 nails. These casks also had the first battens recorded to date. The bottoms had holes in them, which must have been drains, but no definite purpose has been determined.

Four lead patches were found on the casks, including an L-shaped one that folded over the staves and onto the head. Beneath three of the patches were holes plugged by corks. These seem to be examples of the extensive repairs which most of our casks exhibit. It is not known whether lead was used routinely for patching, but these patches were probably installed by the ship's carpenter.

During the 1985 season, it was reported that flagging was found in some casks. Flagging is strips of material used to caulk between staves, another repair method. This season an effort was made to look for flagging before recovering casks to minimize the chance of loss during recovery, and additional examples were recorded.

Graffiti and construction marks were also found. One head reads, "NEW/PRIME OX/MESS BEEF/26 PCS/P.R. LONG/WATERFORD". Waterford is a town near Cork, Ireland, the port from which most provisions were shipped to America. Another head is branded, "G&C PEAS".

Other artifacts will be included in future reports.

Summary

The season's results are summarized in the following description of the ship under study. This description is based upon archival and field data, but contains some suppositions which cannot yet be verified. This description will also serve, to some extent, as a series of hypotheses for further testing. With those caveats clearly stated, here is a description of ship 44YO88:

The ship was a brig of approximately 170 tons, about 68 feet on the lower deck. She was possibly built on the east coast of England, as a coal carrier. She is well-built, of oak frames and planking, and heavily constructed. The ceiling is solid and smooth, exhibiting no vent spaces or bilge wales. She is very full-bodied, with bluff bow. She exhibits unusual bow and stem construction, of horizontal timbers bolted to stem and sternposts.

She was chartered by the Navy Board, probably as a victualler, probably at the standard rate of L 108/month, including a crew of 10. She undoubtedly was loaded in Cork, Ireland, with general supplies and was ballasted with approximately 16 tons of sand, gravel and stone, probably taken on in England. She was carrying coal in her hold for heat and cooking.

By the time she reached Yorktown, she had been fitted with a yellow pine bulkhead, hurriedly and poorly installed in the stern, probably while the ship was in the Carolinas. The officers, aft, had well-appointed cabins; the crew lived in cramped quarters forward. Even though duties may have kept the crew busy, they found time for games. With the ballast in place, headroom in the hold was just over 5-1/2 feet; headroom was probably less in the 'tween decks area. On board, at some point, were troops from the 22nd and 43rd Regiments and Royal Marines.

The ship was probably cabled together with approximately a dozen other ships, with anchors set to hold them in place. Essential stores and equipment were probably moved to shore, then the ships were scuttled by boring holes below decks. YO88 sank in 15-20 feet of water, with no list, but with the bow pitched slightly downward.

She was probably passed over by French salvage operations during the winter of 1781/82 as being too small and because there was too little time for complete salvage of all the ships. Local wreckers undoubtedly removed cannon, anchors, etc., beginning in 1782. Her masts must have been broken off in the salvage attempts. It is probable that local wreckers and swimmers continued to remove items of lesser value for 2 years or more, at which the the upper portions of the hull had deteriorated and the remainder silted in. Little disturbance took place until the ship was rediscovered in 1978.

Acknowledgements

Project sponsors deserve recognition, especially the National Endowment for the Humanities, which has provided funding almost since the project began. The Commonwealth of Virginia, the Department of the Interior, and numerous corporations, foundations and private origanizations and individuals also have assisted, along with countless volunteers and consultants who have contributed skills and materials over the years.

No one could be more grateful than I for the excellent staff that participated at Yorktown in 1986, at a time when so much rebuilding and catching-up had to be done. I want to offer my sincerest thanks—and respect—to: Marcie Renner, assistant director for conservation, and Billy Ray Morris, assistant director for excavation, the two permanent members of the staff; Linda Brown, archaeological assistant; David Cooper, intern from East Carolina University; Barbara Larkin, intern from The College of William and Mary; Tim Panyard, excavator from Indiana University; Eri Weinstein, excavator from Texas A&M University; and those mentioned in the text of the report. For all the others who are too numerous to name, let me assure you that you have not been forgotten.

John Broadwater
Virginia Division of Historic Landmarks
PO Box 368
Yorktown, VA. 23690

RICHARD A. STEPHENSON

Environmental Process in the Vicinity of Roanoke Island, North Carolina

Introduction

The Program in Maritime History and Underwater Research conducted side scan sonar and magnetometer surveys in the vicinity of the northerly end of Roanoke Island in November, 1985. During the summer of 1986, the magnetometer survey was continued and certain 'targets' were subjected to on site observations. The purpose of these surveys and observations off the north shore of Roanoke Island were to narrow down the possibilities of the actual location of the settlement of the 'Lost Colony'. While the location of the settlement has not been found, the elimination process is nearing an end. The work assumes that the settlement is presently underwater. Further, it is assumed that both artifacts and archaeological features associated with the settlement have survived the inundation process.

Coastal Processes: Present and Past

The physical processes in the vicinity of Roanoke Island are related to: 1) the ebb and flow of microtidal currents, 2) inlet processes, 3) freshwater inflow, 4) storm energy, and 5) sea level rise. The lunar tides set up tidal currents or flow. The tidal ranges are fifteen centimeters in Roanoke Sound, fifty-two centimeters at Oregon Inlet, and slightly over a meter at Currituck Light. The tides occur diurnally, but their effect today are minimal. The primary movement of the flood tide is northward from Oregon Inlet through Roanoke and Croatan Sounds, and conversely with the ebb tide. With respect to freshwater inflow, the Roanoke River is the primary contributor as it is the largest drainage basin on the Atlantic slope. The flood flow down the Albemarle estuary occurs during the winter and spring, but is now tempered by six dams. The dams tend to regulate the flow so much that it fails to flush out Oregon Inlet as it has in the past. This was not the case until the settlement of the piedmont in North Carolina and Virginia in the 18th and 19th centuries. Another aspect of the effect of tides is the location and decrease in the inlets. The inlets tend to open and close, migrate north and south, and vary in width and depth. At one time as many as seven inlets were open north of Cape Hatteras and south of Cape Henry. Tides at that time were larger in the sounds than today. Now, only Oregon Inlet is open in the area, which decreases the effect of both storm and lunar tides. Storms probably have the greatest effect on coastal processes such as erosion and deposition along shorelines. Storm tides are commonly much greater than the lunar tides, and the high winds associated with storms allows the impact of waves to occur at a significantly higher elevation along the shore. In addition sea level has risen in the area about 67 centimeters since 1585.

The land surface of Roanoke Island approximates an old marine terrace with an elevation of about three meters above present mean sea level. This terrace known as the Princess Anne is related to a former sea level stillstand period which approximates the middle of the Woodfordian substage of the Wisconsin glacial stage. However, the topography of the island varies from sea level salt marshes to pine and live oak covered relict sand dunes with elevations over 18 meters above mean sea level. The north end of the island has the greatest relief which allows for the development of small streams. It is also in the northern section of the island where most of the archaeological and geomorphological research has been focused. And it is this part of the island where the island's configuration has probably changed the most.

At the present time the northern shoreline is being eroded away at a relatively rapid rate. Due to the closing of all the inlets of Oregon Inlet, tidal current energy has sheared off the northeast facing shore over the past several centuries. With Oregon Inlet's tidal prism, that is its width, depth and flow, decreasing, the currents along the northeast shore are waning. An elongated recurved sand spit has developed because of this change in current velocity, with the ebbing tidal current being more significant than the flood tidal current at the present time. Prior to 1820 as many as four inlets were located north of Oregon Islet at one time. The effect of tidal and storm related currents were much more then, and there appeared to be both a northwest point and a northeast point to the island. By tracing shoreline changes using historical and present day maps and charts, some relatively crude measurements have been made for the purpose of calculating the location of previous shorelines of Roanoke Island.

Reconstructing 400 Years of Seascape Change on Roanoke Island

The location of Roanoke Island including its configuration is related to geologic events since the breaking up of Pangaea. To be sure, the geologic history of this area is important, but it has been sea level rise and the inlet process that has most effected Roanoke Island in the past thousand years or so. Sea level has been rising for about 8,000 to 10,000 years. The rise has been slowing down until recently, and it is expected to increase its rate during the next twenty or so years substantially. During the past 3,000 years sea level rose at a rate of about 17 centimeters per 100 years, and for the past 5,000 years it has risen at a rate of 20 about centimeters per 100 years, and finally for the past 8,000 years the rate of rise has been about 28 centimeters per 100 years. Here, as an aside, we should think about the future rise in sea level which will certainly increase the need for underwater archaeologists unless the land archaeologists begin now to devise management schemes to save important sites from coastal flooding and inundation.

The rise in sea level created Roanoke Island and it will eventually destroy it. In times past Roanoke Island was part of the mainland, but separated itself because of sea level rise several thousand years ago. It is likely that the island will be gone several thousand years from now, or maybe less. The maps and charts of the past tend to show how the island has changed in its location as well as its shape. The northern shoreline shows considerable retreat since 1820. This is particularly the case along the northeast facing shore. The shoreline in the 17th century shows considerable variation between the maps or charts. For example, White's map of 1585 shows a northerly point, while De Bry's map of 1590 shows northwesterly and northeasterly points. The 1590 map also shows three inlets north of Roanoke Island and two south of the island, while the 1585 map shows only one inlet north and one inlet south of the island. These maps show only the latitudinal position so it is difficult to measure changes in the shoreline. The Mercator-Hondius map of 1606 also shows two points of land at the northern end of the island. There are three inlets north of the island and one to the south. On this map, both latitude and longitude are indicated using measurements of angle and time during the early 17th century. The Comberford map of 1657 shows Roanoke Island in an oval configuration with its detail leaving much to be desired cartographically. The First Lords Proprietors' Map of Carolina accomplished by Ogilby in 1672 shows Roanoke Island to be somewhat narrow and elongated. It also shows Carlile Island, or

what is now presumed to be Collington Island very close to the north end of Roanoke Island. The map shows two inlets north of the island and four to the south. The Wimble map of 1733 shows Roanoke Island to have a rectangular shape. There is one inlet to the north and one very near the north end of the island, one inlet that is probably awash at low tide at the island's mid-section, and three farther south. In 1738 Wimble constructed a map for Thomas Hollis Pelman, the Duke of Newcastle, who was the Secretary of State for the province of North Carolina. The map shows two bays on the northeast facing shoreline of the island. In 1876 the U.S. Civil Engineers attempted to measure the change in the shoreline by tracing the then, existing shoreline on Wimble's map. This produced a very crude and inaccurate result. The Collet map of 1770 shows the island to have a northwesterly point with FORT PAIN on the northeast facing shore. Can this be the location of the main fort built by Lane? Or is it the location of the outpost which has been reconstructed by the National Park Service? Or is it the location of another fort built in the 1700's. For purposes here let us hypothesize that PAIN FORT was built over Lane's main fort or that of the Lost Colony. We need to know more about PAIN FORT, and this is being persued. Also, the map shows only one inlet to the north, Roanoke Island opposite the mid-section of the island and two inlets to the south. Monzon's map of 1775 also shows PAIN FORT as well, at approximately the same location as on Collet's map. There is little difference between the 1770 map and the 1775 map except that the longitude is now measured rather accurately from London. A 1794 map also shows the island configuration to be similar to the 1770 and 1775 maps. The inlets appear to be similar as well.

The northerly end of Roanoke Island shows considerable erosion since 1851. However, the changes during the past one hundred years or so are minor compared to the changes that occurred during the 17th century. The approximate shoreline of 1585 on the north end of Roanoke Island shows how inundation from sea level rise, along with inlet changes and erosion and deposition processes have altered the island. It shows the present site of the outpost built by Lane, and Alder Branch where much of the archaeological work has been accomplished. It also shows a bay and a somewhat complex stream system in the vicinity of Shallowbag Bay. It is in this area, offshore of the present island that the "Lost Colony" may be found. The settlers, typically required freshwater, a view to all the navigable channels and inlets, and a promontory. The location, then, would be towards the northwest of the former Shallowbag Bay. The next step is to attempt some sort of substantiation of this hypothesis. And work has already started.

Last summer some shoreline observations were made near Lane's outpost. It was determined that a paleosol is located approximately three meters above present sea level. This is assumed to be the original surface of the island. Today, relict dunes cover the original surface along the shoreline and is being eroded at a rate of approximately two meters per year since 1851. The eolian deposits originally came from the shoals to the northeast and the barrier strand beyond.

Since that time the dunes have migrated inland as the shoreline eroded and have since been built up from the eroded material. This is a common scenario with respect to coastal processes. So, one might expect to find relatively high dunes to the northeast of the island where the main fort could have been constructed. This would be near the shore and close to a freshwater stream.

What's Next

The future surveying work at Roanoke Island is several years away. In the meantime some research related to sediments will be made. This includes the granulometric analyses of sediment making up the existing shoreline as well as some offshore. It is important that the former stream bed be found in the vicinity of Shallowbag Bay. During a flyover last summer, some bottom features off the northeast shore showed some interesting patterns. Hopefully, the sediment analyses will show us the way to the 'Lost Colony'.

RICHARD A. STEPHENSON
PROGRAM IN MARITIME HISTORY AND
UNDERWATER RESEARCH
EAST CAROLINA UNIVERSITY
GREENVILLE NORTH CAROLINA 27834

TONI CARRELL

Noquebay: The Study of a Late 19th Century Schooner Barge

Introduction

Until 1982 the remains of an historic wooden vessel rested undisturbed and nearly forgotten in the shallow waters of western Lake Superior. The vessel was first spotted from the air during a routine fly-over of Apostle Islands National Lakeshore and later, that summer, a park ranger verified the presence of wooden structure exposed on the sandy bottom of a small bay. Knowledge of the site remained sketchy until July 1984 when Submerged Cultural Resources Unit archeologists agreed to visit the site for evaluative purposes. The "rediscovery" of a late 19th century wooden vessel in an excellent state of preservation, and the realization of its potential significance, prompted park management to action. In September 1984 full documentation and analysis of the vessel was undertaken. The results of research on *Noquebay* is presented as a case study and illustrates the potential significance of shallow water shipwreck remains.

The study of the remains of a historic wooden vessel, located within the Apostle Islands in western Lake Superior, was designed within a park management framework. The project was geared toward generating information that would be useful in submerged cultural resources site protection, visitor safety, and interpretation, in meeting Federal compliance requirements, in contributing to the story of the park and the maritime history of the Great Lakes, and in answering questions of general archaeological and historical interest.

The goal of the project was to thoroughly document the remains of an unidentified wooden vessel in an effort to determine the nature and extent of the wreckage which would lead to its possible identification and a determination of its historical significance. The purpose for gathering this information was for the short and long-term management of the site by the National Park Service in cooperation with the State of Wisconsin.

The research questions this study was designed to address were primarily descriptive in nature and fall into three categories:

1. What is the nature of the maritime construction and technology displayed by the historic wooden vessel;
2. How have shallow-water wrecking processes affected site deterioration, preservation, and research potential;
3. What social, economic, and environmental conditions on the Great Lakes, particularly Lake Superior in the latter third of the 1800s, have affected the nature and deposition of shipwreck remains in the Apostle Islands region and how does the vessel in question fit into this historical context?

Site Location

The remains of a historic schooner barge, circa 1872, are located in Apostle Islands National Lakeshore. The vessel lies in a small, shallow cove on the eastern side of Stockton Island (Figure 1). Its unprotected location is subject to heavy surf and breaking waves from winter storms that come out of the east/northeast. Summer storms normally do not impact the site as their direction of travel is out of the west/southwest. Sand deposited over the site throughout the summer months is scoured out by winter storms. Ice shelving and movement had done little overall damage other than directly contributing to the vessel's initial breakup.

Project Background

Until 1982 the vessel off Stockton Island rested undisturbed and nearly forgotten. The vessel was first spotted from the air by Service personnel and later the presence of wooden structure confirmed by Park Ranger Elen Maurer. Known only to Park staff, it wasn't until two years later that Park funding became available to study the vessel.

The project was a cooperative effort of the Submerged Cultural Resources Unit and the Park, with the majority of the labor for on-site documentation provided by local volunteer sport divers. Volunteers in the project were required to participate in a short submerged cultural resources documentation course in order to familiarize them with non-destructive techniques for data retrieval.

Vessel Background

Archival and local historical research lead to a tentative identification of the wreck as that of the schooner barge *Noquebay* (figure 2). The vessel, launched at Trenton, Michigan, in 1872, was built specifically for the bulk lumber and coal trades. She was 205 feet long, her beam was 34 feet, and she had a hold depth of 12 feet 6 inches.

Noquebay and her sister ships, *Peshtigo* (1869), and *Mauntenee* (1873), were frequently towed by the wooden steamer *Lizzie Madden*.. The trio made regular trips between Duluth or Ashland, and Buffalo or Tonawanda, major lumber producing and distribution centers. It was on one of these trips that *Noquebay* and *Mautenee*, in tow of *Lizzie Madden*, departed Bayfield, Wisconsin, heavily laden with lumber. When the steamer had traveled approximately 20 miles east of Bayfield, *Noquebay* caught fire in the forward part of the ship, apparently in the area of her donkey boiler. *Lizzie Madden* was able to beach Noquebay in 15 feet of water on the east side of Stockton Island. The vessel was reported to have burned to the waterline.

Site Discussion

The vessel lies broken and scattered directly offshore on a coarse sand bottom that gradually slopes eastward toward the open lake. Depth of water over the site ranges from 8 to 12 feet. The wreckage field trends in a north-south direction for approximately 230 feet and is nearly 125 feet wide. The site covers 28,750 square feet, nearly 2/3 of an acre.

The arrangement of the various components represents a vessel that settled squarely on her bottom. As wave action, surge, winter storms, and ice shelving attacked the partially burned vessel, she began coming apart at points of structural weakness. Port and starboard sides fell outward, leaving the entire bottom exposed. The vessel's remains consist of five major components: keelsons, port side, starboard side, and bow.

The wheel, which was found partially exposed in the deep sand that covers the site, is 67 feet southeast of the stern deadwood on the starboard side of the vessel. Still articulated to the mechanical steering mechanism, it is in remarkably good condition. The only obvious attrition being the deterioration of the wood on the hand grip spokes and a crack in the rim. Its diameter is 4 feet 5 inches, while the 8 spokes each measure 22 1/2 inches overall.

The mechanical steering gear and spindle are well preserved. The guide rods are in place, as are the yoke and yoke belt. Both the coupling rods and one of the cross-heads are missing, however. The

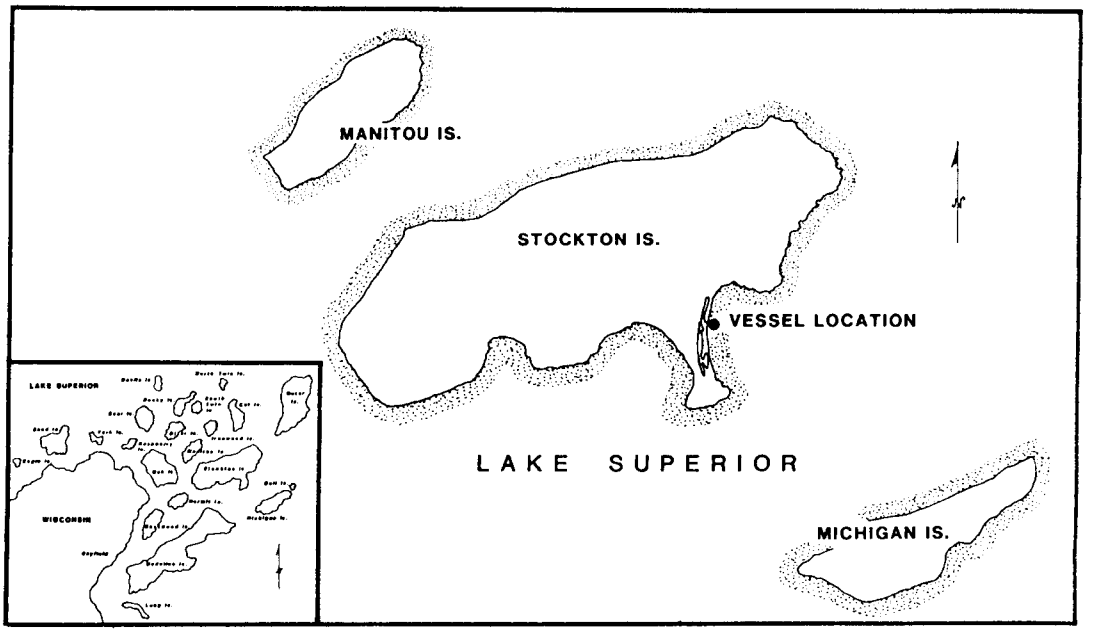


FIGURE 1. Location of Stockton Island and *Noquebay*.

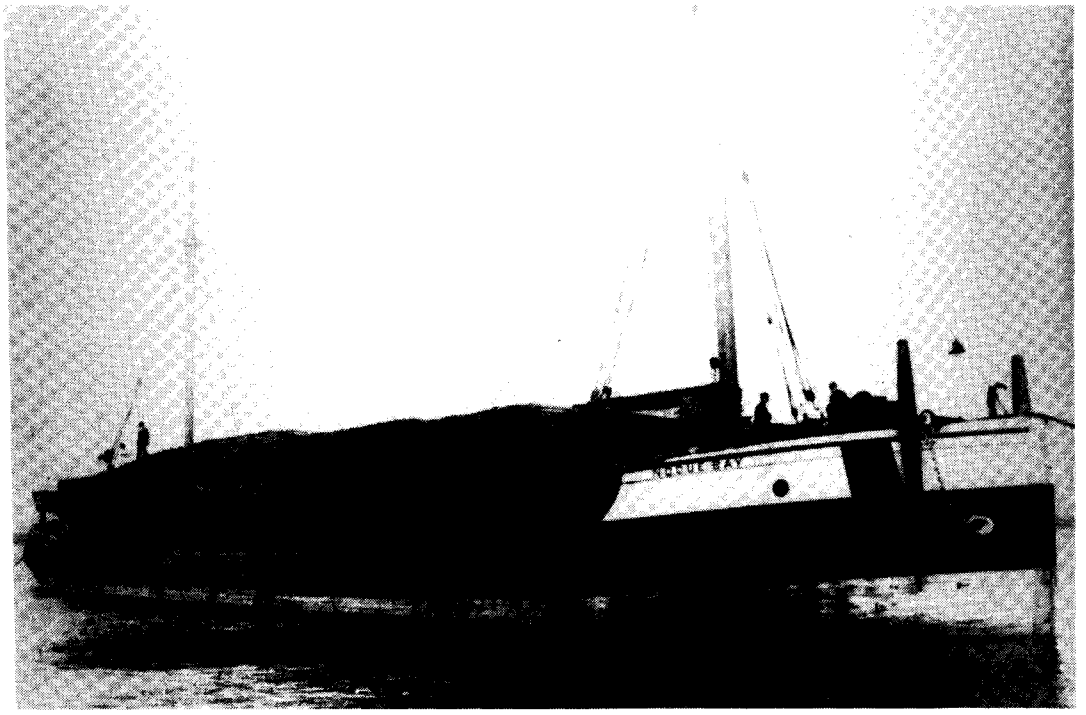


FIGURE 2. The schooner barge *Noquebay* was built in 1872 at Trenton, Michigan for the Peshtigo Company. This photo, taken in the 1890s, shows the vessel heavily laden with a lumber cargo. Photo courtesy C.P. Labadie, from the Herman G. Runge Collection, Milwaukee Public Library.

overall length of the steering mechanism, including the wheel, is 5 feet. The name of the manufacturer of the assembly is still visible on the wheel rim: they were Coffin and Woodward, Boston. Following mapping, photo, and video documentation of this feature, it was reburied to insure its continued preservation.

The centerline keelson, sister keelson, and floor keelsons show very little deterioration. One hundred fifty-four feet six inches of intact bottom is present. The interior width of the bottom to the floor keelsons is 28 feet (figure 3). The vessel's width outside was 34 feet 8 inches. The floor keelsons are 2 feet 9 inches from the thick strakes at the turn of the bilge, and are 12 inch by 8 inch timbers. The port floor keelson is only intermittently exposed due to sand overburden, however a full 83 feet of starboard floor is exposed.

The centerline keelson consists of several elements: the main keelsons, the port and starboard sisters, an extra section of port sister, and a rider. The main keelson is composed of two stacked timbers, each 14 by 14 inches. The main broke at a point of structural weakness in the stern, the hooked scarf. All of the scarfs along the centerline are a uniform 5 feet in length. The rider keelson, resting atop the main, is also 14 by 14 inches. The extant length is 28 feet 6 inches. The rider steps down to meet the main keelson 35 feet forward of the stern break. When the main keelson gave way, the rider broke with it.

Immediately forward of the main keelson break is a 4-inch diameter groove that passes through the rider and main keelsons and extends to the limberway. The groove, present only on the port side, is most likely a bilge pump access. No remains of the bilge pump were located.

The mizzen mast step, cut out of the rider from the starboard side, is 18 inches long by 9 inches wide. Two wood blocks are fitted into this space, making the mortise overall dimensions 14 by 6 inches. A wooden scab reinforces the step on the starboard side.

Remains of the centerline hold longitudinals, or stringers, measured 9 inches high by 3 inches wide. Stanchion post remnants measured 6 by 6 inches. Three sections of longitudinals and stanchion posts were identified on site.

An unusual feature on the main keelson appeared near the bow. The keelson narrows to a width of 9 inches and then flares out once again to its full 14 inches. The length of the narrowed area is 18 inches. Immediately forward of this area are wooden caps on the top and sides of the keelson. The location of this narrowed area, in proximity to the bow and the reinforcing keelson caps suggests that this may have been the point at which the tow bitts tied into the keelsons. The last several feet of the main keelson, toward the bow, show clear evidence of burning.

The sister keelsons are 12 inch by 14 inch timbers. With the exception of evidence of burning in the bow area, they are undamaged. Wooden caps appear at regular intervals on both the starboard and port sisters. The beginning and ending points of the extant stanchion longitudinals coincides with these caps. The caps were placed on the sisters directly under the hatch openings. Based upon the number of keelson caps found on the vessel, it appears she had four hatches. All hatches, with the exception of the forward hatch, were the same length, 10 feet 6 inches. The number one hatch was 6 feet 6 inches long.

An extra sister keelson was discovered on the port side. A single timber measuring 12 by 14 inches, it is 37 feet 6 inches long. This extra sister is not duplicated on the starboard side. According to the Inland Lloyds Register, *Noquebay* was equipped with a centerboard. While remains of a centerboard were not found, other anomalous features found on the port keelson strongly suggest the area of the extra port sister as the probable former location of the centerboard.

The most interesting anomaly is the abrupt appearance and disappearance of triple frames just aft of the extra keelson and at intervals forward along its length. The change from the standard double framing pattern, 6 by 12 inch doubles on 24 inch internal reinforcement may have been to accommodate the centerboard.

The port bottom, with the exception of the floor keelson and the turn of the bilge, is buried. The starboard bottom is exposed and intact to the turn of the bilge. Ceiling planking varies in width from 10 to 14 inches, with a uniform thickness of 3 inches. The planks are double fastened with 3/4 inch square nails.

Thick strakes at the turn of the bilge are 5 1/2 inches thick by 10 to 16 inches wide. Coaks appear for the first time, in the construction of this vessel, in the bilge ceiling. The 2-inch coaks are spaced on 24-inch centers. The bilge ceiling fasteners differ from the bottom in that the double fasteners alternately have 1-inch diameter clench washers. This fastening pattern continues to the main deck (figure 4).

Truss rod and turnbuckles are present in abundance on the site. Only five turnbuckles, of a probable six were located. The truss rod, uniformly 1 1/2 inches in diameter, articulated with the turnbuckles to reduce longitudinal hogging of the hull. It appears that in the case of *Noquebay*, the rod passed up through the deck near the bow, ran down the deck to the stern and then below to the deadwood in the same manner as found on another Great Lakes schooner, *Willie Loutit*, built the year after *Noquebay*.

The truss rod articulated with the deadwood in the bow and in the stern by means of two metal straps, through-bolted in the deadwood. This pair of straps, tied into the bow deadwood, measured 6 inches wide, 1 inch thick, and 7 1/2 feet long. A similar, although apparently disarticulated, feature was found in the stern.

In an effort to deal with the problem of transverse strains in *Noquebay's* hull, her builders used a wide strap, running longitudinally at the level of the main deck (figure 4). The strap was placed directly over the deck beams, at the level of the decking, and tied into the beams and knees by fasteners. The size of the fasteners on the knees are the same size as found in the strap, and the spacing and angle of the holes found on the strap correspond to the spacing and angles of the knees.

The visible pieces of the port side are broken into three distinct sections. One long section is outboard up, a second has only the tops of the frames showing, and the third is broken and partially buried. Two large sections of the starboard side are present and intact from just above the turn of the bilge to the main deck. Both sections are partially buried with only the frames above the turn of the bilge and tips of the knees exposed.

The vessel has knees that measure 6 1/2 inches by 24 by 38 inches, that are space irregularly between 36 and 46 inches apart. Fasteners through the knees are 7/8 inch nails with 1-inch clench washers. Examination of deck beam remnants revealed they were 8 by 10 inch timbers.

The bow, broken aft of the deadwood, is a short distance away from the hull bottom. This largely intact section lies on its port side with better than half of the structural remains including the keel, buried in deep sand. Frames and hull planking, down to the level of the limberway, are exposed. Hull planking varied in width from 7 to 10 inches and is uniformly 3 inches thick. This resulted in a very thin-skinned vessel by Great Lakes standards. The deadwood is composed of four stacked timbers, each 16 by 14 inches. The sternson, apron, and stem are in situ, and three of the vessel's engraved draft marks are well preserved.

Visible evidence of the fire which contributed to *Noquebay's* loss is greater in the bow than anywhere else on the site. The deadwood

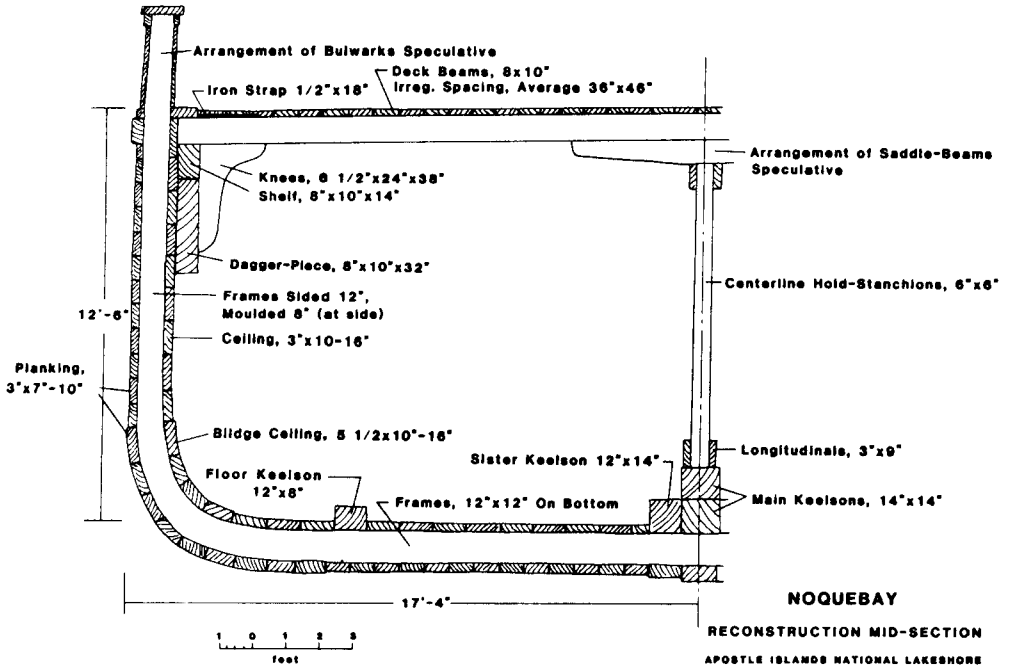


FIGURE 3. Hull Cross Section

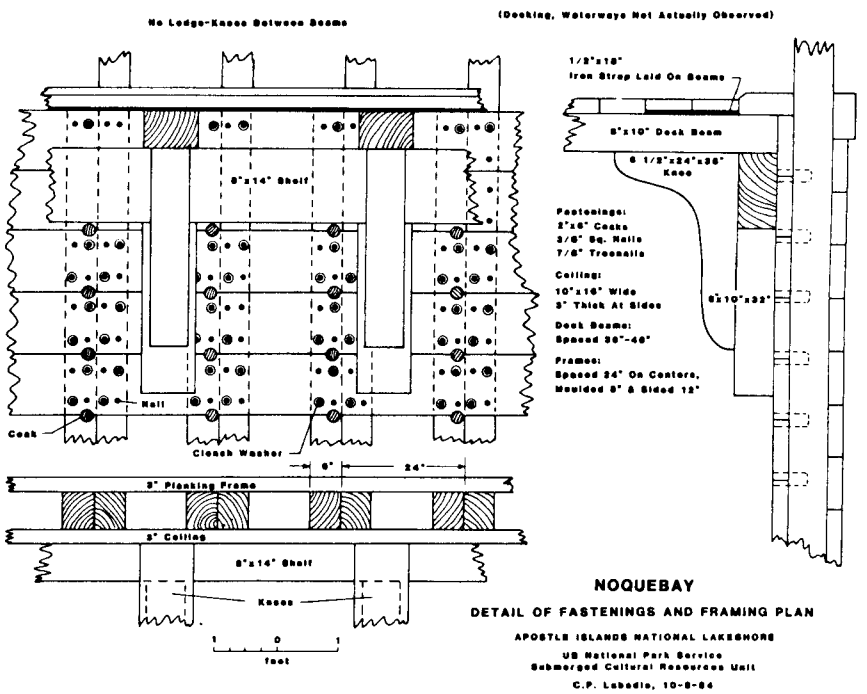


FIGURE 4. Detail of fastenings and framing plan

is burned and charring of the frames and ceiling is evident.

Two pieces of machinery are present in this area, a cylindrical donkey boiler and windlass. The donkey boiler is resting on its side just aft of the deadwood. It measures 7 feet long by 4 feet 6 inches in diameter. *Noquebay's* boiler was not used in connection with her propulsion, rather it was used to supply steam to run a bilge pump, and for working steam-powered deck machinery. The disarticulated windlass lies adjacent to the deadwood. The geared driving wheel is exposed, while the cross head and side-bitts lay near by. The cast-iron frame is embossed with the name of Globe Iron Works, Cleveland.

The bow contains a rich assemblage of artifacts, including a cast iron cooking pot, spiral wood auger, jig hanks, mooring bitts, boiler grates, coal, the ship's bell, as well as an assortment of fasteners and boiler piping. These artifacts are covered and uncovered seasonally as the sand on the site builds during the summer months and then is scoured out by winter wave action.

Summary

During the investigations of the historic wooden schooner in Julian Bay, we did not locate any single piece of evidence that would conclusively prove that the vessel is *Noquebay*. When taken together, however, the historic record and the physical remains leave little doubt about her identity. The vessel is in an excellent state of preservation. The seasonally exposed portions represent 90% of the bottom, 55% of the starboard side, and 40% of the port side. *Noquebay* shows little evidence of natural impacts resulting from wind-driven waves and winter storms. It is not unusual for 6 to 9 foot waves to roll and break across the site which is in only 8 to 15 feet of water. While these storms do scour out the deep sand which has protected the site, even the delicate draft marks, still filled with paint, are undamaged.

Noquebay's excellent state of preservation and the potential richness of her artifact assemblage, forces one to take another look at the complexity of wrecking processes. It clearly dispels the myth of the "shallow, jumbled shipwreck" not having enough integrity to yield a great quantity of data. This vessel is, without a doubt, eligible for National Register listing.

Toni Carrell
Submerged Cultural Resources Unit
National Park Service
PO Box 728
Santa Fe, NM 87504

SYMPOSIUM

Mark Wilde-Ramsing

Search for the Keys to the Boat

Introduction

A prominent portion of North Carolina's underwater archaeology program during the past decade has involved its environmental review system, which seeks to protect historic shipwrecks and other submerged sites from water-related construction projects. Backed by federal legislation, the North Carolina State Historic Preservation Office has developed a strong review program for historic buildings and terrestrial archaeological sites since 1968 and beginning about 1976, the Underwater Archaeology Unit (UAU) took an active role in protecting submerged cultural remains through the review process.

At the 1982 Conference on Underwater Archaeology, the UAU presented a paper entitled "Project Review and Assessment Procedures", (Lawrence and Wilde-Ramsing: 1982). It dealt with the specific steps that the UAU takes when reviewing state and federal permit applications for construction projects affecting state-owned bottom lands. The vast majority of applications are not million dollar navigation improvements but are individual permits for private construction projects. Since many of them occur in historic harbor areas, collectively they can have a very detrimental affect on submerged archaeological remains.

The 1982 review procedures outlined the type of historical and archaeological data reviewed by the UAU staff to determine the potential a prospective construction site has for affecting submerged archaeological resources. The nature and size of a proposed project also has a bearing on the UAU's recommendations to the permitting agency. For all projects affecting recorded underwater archaeological sites, a field investigation is requested. On large projects where historical research indicates a good potential for submerged archaeological remains, recommendations call for historical and archaeological surveys which may be phased in such a way that it can be cut short should preliminary indications reduce the probability of finding submerged sites.

The 1982 procedures gave the UAU's review system consistency and has worked well. Eleven survey and assessment projects have recently been conducted to determine the nature and extent of submerged archaeological remains in areas slated for private construction activities. The deployment of teams of contract underwater archaeologists, as expected, has resulted in the finding of a number of sunken remains, primarily small craft from the turn-of-the-twentieth-century. The following story of the Manteo shad boat is offered to illustrate the problems these not-so-old finds have created in terms of determining their significance and in turn, figuring out what to do with them when threatened with destruction.

Discussion, Manteo Shad Boat

Central to the commemorative festivities celebrating the 400th Anniversary of the founding of the Roanoke Colonies (1584-87) has been the building and christening of the *Elizabeth II*, a replica of a vessel that brought the first English colonists to America. As plans were drawn up during the early 1980's, it became evident that large-scale dredging was necessary to create a berthing basin, access channels and bridge alignment in the small harbor at Manteo, North Carolina.

Because of the historical and archaeological potential of the "Lost Colony' site, the North Carolina Division of Archives and History recommended an underwater archaeological survey be conducted prior to dredging. There was only a remote chance of locating evidence of early historic activities; however, a greater potential existed for submerged materials of the late nineteenth century and early twentieth century when Manteo was the county seat and the hub of small boat traffic from the surrounding area.

Initially, a systematic survey of the project areas was performed using a proton precession magnetometer to isolate magnetic disturbances, any of which might be generated by cultural material. Following this, a diving and probing search was conducted on isolated targets to determine their source.

With the exception of the remains of a sunken vessel, Underwater Site 0001ROS, all magnetic disturbances were attributed to scattered cultural debris of recent origin and were determined historically and archaeologically insignificant. Recommendation for the sunken vessel located on the south side of the proposed berthing area were either complete avoidance during construction activities, or further documentation through historical research and on-site investigation, in order to assess its significance (Wilde-Ramsing: 1982).

Unfortunately, avoidance was not possible and a year later investigators were back in Manteo attempting to determine the significance and appropriate treatment of the sunken vessel. The remains represented a 24-foot wooden vessel fastened with iron nails and propelled by an internal combustion engine. It was evident that the vessel had been salvaged and burned.

The intact portion of the vessel consisted of its lower hull, which was well-preserved in the soft bottom sediments. The investigative strategy was to gently loosen the sediment around the vessel and carefully move it to a protected spot in the next cove. This tact would preserve the remains in a similar environment for future research with minimal disturbance.

The reality of the situation, however, was that one does not easily move a 24-foot vessel in a waterlogged and deteriorated state 300 yards, particularly a North Carolina shad boat such as the one in Manteo. In these type craft, the floor frames are not locked to the keel by a keelson. The boat therefore had to be removed from the bottom, piece by piece, and reconstructed on a nearby barge platform. Once this was completed, the reinforced boat hull was moved to a work area where it was stabilized through applications of linseed oil and thoroughly documented.

From field analysis it was ascertained that the remains represented a deadrise skiff used in the shad fishing industry. It was built locally about 1920 as a motor-driven vessel and at some time later, the engine was moved amidship and a cabin was built over it. Its unique features include iron fastenings rather than copper clinched rivets, butted rather than lapped frames and a finely carved, juniper keel piece, which is characteristic of all shad boats. It is one of approximately fifteen shad boats that exist today and is a good example of a transitional form between round bottom and flat bottom construction as well as representing a very early motorized version.

Finally, the state archaeologists recommended that the remains of the shad boat be stored in Manteo and at a future date be incorporated into a display on local fisheries. Despite attempts to promote the shad boat, its importance simply could not hold water when placed beside the *Elizabeth II*, herself. For the past three years, the remains have sat neglected and unattended, precariously perched on two saw horses. Recently, at the state's request, the Manteo shad boat has been received into the collection of the North Carolina Maritime Museum and placed in a protected storage area.

The basic dilemma created during the Manteo investigation and several environmental review contract surveys since then, center

around what to do with turn-of-the-century small boat remains. On the one hand, developers and permitting agencies are wondering how a relativley modern vessel, such as a small motorized boat retains a level of significnace that warrants time delays and alterations to a construction project. On the other hand, local maritime historians indicate that 1870 to World War I was the most innovative and revolutionary period in North Carolina boat construction. It was a time when a number of local vessel types evolved, such as the shad boat and the Core Sound sharpie. These indigenous craft, when analyzed, help provide a cultural and economic profile of the people and times that produced and used them.

Furthermore:

> 'There are virtually no historical records to show the size, shape, and nature of the boats of the days of sail and early powerboats. It has never been the practice of small boat builders to make drawings or leave records. There is no alternative but to go into the field and search out the remaining evidence'.
>
> (Alford 1982: 6)

Part of this paper's title is 'searching for the keys to the boat', which was a joke that came out of frustrations from dealing with "modern" vessel remains. A planner from the Corps of Engineers was asking if there was not an accepted cutoff date after which vessel remains are too recent to be archaeologically important. Furthermore, he felt there must be diagnostic keys that provide field investigators the evidence to quickly identify vessels of recent origin. The response was that if the investigator found the keys to the boat, it must be a post World War II motor boat and therefore was not likely to be significant. Although funny at the time, the realization quickly set in that understanding of maritime activities for the last 100 years is weak. This has greatly hampered attempts to deal quickly and effectively with sunken remains of this period particularly as they become threatened by a dredge or pile driver.

Workshop Series

To compensate for this weakness, the North Carolina Underwater Archaeology Unit is sponsoring a series of maritime workshops. Two workshops have been held this year with an additional three planned in 1987. Participants are professionals from state and federal agencies, a maritime museum, a university maritime history program, and a private contractor, all of whom are based in North Carolina. Totaling nine individuals, this small group comprises the core of professional expertise concerning North Carolina's submerged maritime remains.

The first workshop business was to narrow the subject to a manageable size. Although the management of most periods and categories of North Carolina vessel remains need attention, participants focused on turn-of-the-twentieth-century small craft remains, since they had been particularly troublesome during the environmental review process. The subject was further defined as watercraft that were generally less than 40 feet in length and were built after 1870 and prior to World War I, a period designated as Early Modern.

The treatment of vessel remains encompasses three general areas: site identification; determination of significance; and data collection. The workshop series has been organized to address these topics through discussions that are lead by appropriate participants. The areas of site identification entails determining, from a field examination of physical remains, the type of vessel and period represented. North Carolina is fortunate to have a singular authority on local boat types, in Mike Alford of the North Carolina Maritime Museum. He has spent portions of the first and most of the second workshop outlining the types of vessels known to have existed in North Carolina throughout man's existence. Special attention has been paid to vessels of the Early Modern period by expanding on specific types and their identifying features.

Geoffrey Schofield, a master boat builder also with the museum, is leading a workshop session on the materials used in boat construction. By examining the whole array of construction materials, an attempt will be made to elicit those indicators that can provide a reliable date range. For instance, when was plywood available to boat builders or how can machine-made screws be differentiated from hand-made screws? With certain materials identified and their associated date ranges established, a mean date of construction for a vessel may be reached.

Given that small craft remains are identified and dated to the Early Modern period, how then is its relative significance determined? Participants realize that a determination will be based largely on Alford's discussions of boat types and gaps in the existing knowledge. However, the historical context of Early Modern vessel types has never been seriously researched. Such a study is necessary to support significance determinations of individual vessel remains. Dr. William Still, a naval historian at East Carolina University, will lead a session aimed at identifying reference sources that are available for such a historical synthesis. In turn this document will shed light on the number and type of vessels that may have once floated, thus providing an idea of the number of submerged vessel remains that exist. Background research of the period may also identify vessels that hold individual significance because of their association with a person, place or event. Perhaps more importantly, an historical synthesis will produce information that either lessens the need for costly field research or focuses that research on important aspects of a vessel.

Determination of significance, as well as vessel identification is closely intertwined with procedures for data collection. The more significant a vessel is, the more intense field documentation should be when destruction is imminent. A three-tiered system of recording vessel remains has been accepted by workshop participants. Level I documentation provides an initial indication of vessel type and age, and normally can be accomplished in a few hours of field time. A check list has been developed for field investigators, that includes such categories as length and beam measurements, configuration of hull, condition of vessel and environmental setting.

A workshop session will be held at the site of an abandoned small boat dating to the Early Modern period, which is currently on dry land due to drought conditions. The vessel's accessibility will facilitate a discussion by Gordon Watts of Tidewater Atlantic Research, on difficulties and limitations in collecting data useful to maritime architects due to environmental and contractual constraints. This session will be aimed at establishing guidelines to be used in collecting Level II data, which should include body profiles and details of the bow, and propulsion system.

A flow chart has been devised to direct the intensity of documentation committed to each wreck. All abandoned or lost vessel remains, despite age or size, are documented to Level I, which collectively will provide base data for distributional studies. Those vessels that predate World War I and are not manufactured boat types require additional attention in the form of Level II investigations. Level III is reserved for those vessel remains that exhibit significant archaeological features or historical association. Information retrieval at Level III is extensive and aimed at fully documenting a vessel, with direction provided by its significance.

Finally, the workshop agenda includes several small sessions led by other participants on topics such as the Corps of Engineers permitting systems, anthropological approaches to North Carolina's maritime remains, and processes affecting wreck deposition.

Expectations

The information presented and accepted. In some cases, such as the historical synthesis, grant money will be sought to carry out the group's recommendations. The final outcome will be a management summary of small vessel remain's dating to the Early Modern period, with a historical overview, a glossary of maritime terms, field manuals for data collection, flow charts and problem orientation for directing significance determinations and information retrieval. The use of loose-leaf binders will promote flexibility by allowing changes to be made to any portion of the management document as knowledge grows and techniques are refined.

The search for the keys to modern, Sunken vessels is not being taken lightly in North Carolina. The experience gained from the workshop series will not only produce a viable plan to manage these relatively recent cultural resources, but provide a framework for developing similar plans for other places and periods of maritime history.

REFERENCES

ALFORD, MICHAEL BOYD
1982. *New Contributions to the History of Small Craft* in North Carolina. A paper submitted to North Carolina Maritime Heritage Conference II, Wilmington, N.C.

LAWRENCE, RICHARD W. AND MARK WILDE-RAMSING
1982. *Project Review and Assessment Procedures.* Paper presented to the 14th Annual Conference on Underwater Archaeology. Philadelphia, PA.

WILDE-RAMSING, MARK
1983. *A Cultural Resource Evaluation of Submerged Lands Affected by the 400th Anniversary Celebration, Manteo, N.C.* Ms. on file, Underwater Archaeology Unit, Kure Beach. N.C.

MARK WILDE-RAMSING
UNDERWATER ARCHAEOLOGY UNIT
DIVISION OF ARCHIVES AND HISTORY
P.O. BOX 58
KURE BEACH, NORTH CAROLINA 28449

LESLIE E. BRIGHT

Candied Canoes of North Carolina

Introduction

Phelps Lake, a natural lake in eastern North Carolina, is providing archaeologists with a significant resource which, until recently, has been considerably limited. A current total of 22 prehistoric dugout canoes has been found at the lake, and is expected that many more dugouts exist in unexplored portions of the lake, both above and below bottom. Radiocarbon analysis of wood samples from two canoes yielded dates of 2720 70 B.P. and 1850 60 B.P., making them by far the oldest water craft to be discovered in North Carolina. Several canoes have now been successfully treated using sucrose impregnation at the preservation laboratory of the Underwater Archaeology Unit North Carolina Office of State Archaeology.

With the realization that the prehistoric remains lying in Phelps Lake are of considerable archaeological significance, energies are being direct at obtaining funding for more comprehensive archaeological survey and preservation projects. These efforts will result in an inventory of those prehistoric Indian remains and a comprehensive management plan for their future protection, study, and interpretation.

History

Phelps Lake is located in northeastern North Carolina between Washington and Tyrrell counties and below Albemarle Sound. The oval-shaped lake covers approximately 16,600 acres and is seven miles across at its widest point. The lake waters are replenished only by rain water, since it has no natural inlet or outlet. The nearest body of water, except nearby swamps, is the Scuppernong River some four miles away. The lake basin itself is at a higher elevation (12 to 15 feet above sea level) than the surrounding country side (eight feet above sea level). Average water depth is four feet with a maximum of nine feet recorded near the center. The lake bottom is predominantly sand, however some areas near shore contain a muddy sediment up to one-foot thick. The lake is highly acidic with a pH of 4.65, which probably accounts for its exceptional ability to preserve organic material. In spite of this acidity a diversity of plant and animal species abound in the lake, although algae is practically nonexistent. Several varieties of water fowl use the lake during their migratory journeys including Canada geese, swans, egrets, heron, and most duck varieties. Bald cypress and sweetgum trees predominate on the north, east, and south portions of the lake rim, and some pine trees are found on the west margin of the lake.

Phelps Lake, is unique in several other ways. Its very geologic origin cannot be agreed upon by scientists and scholars. Some who

place it in the category of "Carolina Bay Lakes" along with Lake Waccamaw, White Lake, Black Lake, Singletary Lake, etc., think it was formed by meteors striking the earth. Others argue that the effects of melting glaciers or artesian springs rising through moving ground water formed the lake some time during the Pleistocene period, 500,000 to 2,000,000 years ago.

Indians inhabited the shorelines of Phelps Lake for several thousand years prior to its discovery by European Americans. Those natives must have abandoned or been driven from the area by the late eighteenth century. Since colonial records fail to mention an Indian presence at Phelps Lake.

Due to the thickly forested swamplands which surround Phelps Lake, it was not discovered by white settlers until August 23, 1755 when Josiah Phelps and Benjamin Tarkinton happened upon the lake while looking for farming and hunting lands. During the 1780's, Josiah Collins and others from nearby Edenton, North Carolina formed the "Lake Company" and set out to drain the lake and use its bottom for farming. Collins imported 200 slaves from Africa for this effort, who labored to dig a large canal 20 feet wide and six feet deep from the lake to the Scuppernong River. That attempt to drain the lake failed due to excessive rainfall, but Collins successfully used the canal to drain land near the lake for farming and for transporting his crops to the river for shipment.

Despite its discovery by whites over 200 years ago, the lake remains remote and unnoticed even today, partially due to the sparse local population and great distance to the nearest large town. Typically a few bass fishermen or occasional nature lover venture out on the lake through its single public access. The State of North Carolina acquired the lake from the federal government in the 1930's, and in years since has gained title to major portions of its shoreline, which are administered by the North Carolina Division of State Parks.

As a result of the parks personnel activities in and around the lake in November 1985, two charred log fragments were observed in the shallows by Mike Dunn, park naturalist, who brought them to the attention of the Office of State Archaeology. Members of the Underwater Archaeology Unit examined the logs and determined that they had been shaped by charring and scraping to form shallow canoes. A random search of the lake area known as Big Point revealed a large number of Indian pottery fragments, however, no other canoes were found at that time. The two canoe fragments were removed from the lake to the preservation laboratory at Fort Fisher for preservation treatment. One measured two feet by eight feet in length and the other two feet by four feet, eight inches. Samples were taken for radiocarbon dating and wood identification.

Within a few days of the original discovery Mike Dunn reported finding another canoe, this one in excess of 30 feet in overall length. The third canoe was completely buried in the lake bottom except for a small portion exposed by swans, as they scratched the lake bottom in search of food. The decision was made to recover the third canoe also, due to the rarity of prehistoric canoes in North Carolina, and reasonable concerns for its security.

Excavation and recovery of the complete canoe followed in February 1986. The presence of a broken clay pot associated with the canoe proved very interesting. Part of the pot lay inside the canoe and near its center. The remainder lay under one side of the canoe, adjacent to the first part. That position of the pottery fragments in direct association with an aboriginal canoe has significant implications for dating of both the pottery and the boat, as well as functional interpretations for the larger archaeological site. After excavation the canoe was removed in three pieces to a specially prepared container near the Pettigrew Park Office to await preservation.

Treatment

In mid-April 1986, preservation of the first two canoe fragments was begun. During a preliminary cleaning and rinsing, the canoes were examined and their condition assessed. The wood appeared to be badly decayed, spongy, and very soft. Sucrose was selected for impregnating the canoes, following recommendations and procedures prescribed by James M. Parrent in his paper entitled *The Conservation of Waterlogged Wood using Sucrose*. The canoes were placed in 15 gallons of water, with sugar added to form a 20 percent solution by weight. Sugar was added weekly at the rate of 10 percent by weight until a 100 percent solution by weight was reached. One pint of phenol was added to the solution at the beginning of treatment to prevent fermentation. To conserve sugar and cut cost, the canoes and solution were sealed between two pieces of 6-mil polyethylene film in the preserving tank. This was accomplished by filling the tank approximately half full of water, covering it with polyethylene film, and putting the canoe and solution on top. After the second layer of polyethylene film was placed over the canoe, the tank was completely filled with water. This squeezed out air bubbles, allowing the sugar solution to completely envelop the canoe. This phase lasted 9 weeks.

The fragments first recovered were allowed to dry inside the laboratory at ambient temperature and humidity. Weight loss subsided after approximately eight weeks. The stabilized weight of the fragment noted earlier was 45 pounds. No appreciable change has been observed in physical dimensions or shape of either fragment. Before treatment, one of the canoe fragments weighed 69 1/2 pounds. After treatment it weighed 72 pounds, indicating that 2 1/2 pounds of sugar had penetrated the canoe.

With the apparent success of the sucrose treatment, work commenced on preservation of the 31-foot canoe. Approximately 75 percent of it remained intact. The inner bottom was charred and approximately two inches thick. The exterior (cambial) layer of the log showed no signs of having been modified, although some hewing and scraping by the prehistoric craftsmen seems reasonable. The sides near the top averaged one-half-inch thick. Overall condition was very similar to the canoe fragments treated earlier. Pettigrew State Park officials carried out the preservation process in a manner similar to that described earlier.

After treatment the canoe was placed in a wooden cradle for drying and eventual display. Some areas along the thinner portions of the sides tended to roll outward during drying and slight cracking across the grain was noted in a few areas. Overall, the process was considered a success, however, extra consideration should be taken into account during the drying periods of material with configurations having such great dimensional differentials.

Recent Work

More systematic examination of the lake environment by park officials and other interested persons soon increased the canoe count to 15. In addition to canoes, a number of whole clay pots of various sizes and major vessel fragments were discovered. These were mostly sand tempered, with net impressed, fabric impressed, cord marked, and plain/incised surface treatments predominating. Several soapstone vessel sherds were also found. Some soapstone tempered ceramic sherds had lifting ears or lugs typical of Marcey Creek and Croaker Landing types typical of the Late Archaic/Early Woodland transition periods in coastal Virginia and North Carolina (Egloff, 198). A number of Archaic and Woodland period stone points and knife blades were found along with atlatl weights and stone gorgets. One polished stone amulet or ornament with unusual markings remains problematic. Many pot sherds and lithics were surface collected with only general locations noted. As a result and as the number of cultural materials quickly increased, a moratorium on additional collecting was imposed by the State's Chief Archaeologist until an inventory and methodical survey could be conducted by trained archaeologists.

In October 1986, staff from the North Carolina Underwater

Archaeology Unit North Carolina Maritime Museum, and students for East Carolina University set out to inventory, photograph, measure, and record exact locations for all 15 canoes known to be in Phelps Lake. Applied methods included: surveying and plotting each canoe on a map of the lake with the use of a transit and an EDM (Electronic Distance Meter); a minimal amount of dredging on the ends and along the sides of the canoes to allow measurements and photographs to be taken; collecting incidental cultural materials in the immediate proximity of the canoes; and back filling all dredged areas upon completion of the project. As work progressed during the three week project, new discoveries quickly increased the number of canoes to 22. Four were found to be complete and range in length between 26 and 37 feet. Average beam widths vary between two and three feet. Several canoes are nearly complete with on one end missing and all appear to have been charred and scraped or dug out very meticulously. The craftsmanship required to achieve such thin walls with primitive means can only be described as superb. Charring was also observed on the outside of the canoe ends, which are generally rounded, although there are some exceptions. Two have a peak or overhang on one end, while another is formed with a sharp, raked bow as found on modern vessels. One lacks any form of symmetry on its ends and contains a peculiar squiggle near its middle; hence, it has been referred to as the "retarded canoe". The largest, a 37-footer, exhibits what appears to be a seat or foot rest approximately two and a half feet from one end. Only one canoe, located near shore, seems crudely made, or incomplete. All the canoes apparently were formed from bald cypress logs similar to those found growing around the lake today.

Conclusions

Data collected during the project are presently being compiled by Ms. Kaea Morris, a graduate student with the Maritime History Program at East Carolina University. As funds are provided, wood samples collected from the canoes will undergo radiocarbon dating. The canoes in the lake shall remain undisturbed in the foreseeable future. Efforts are underway through State Parks and the Office of State Archaeology to seek funds for a facility to house and display materials recovered from the lake and to provide funding for additional archaeological investigations. The initial work has covered only three of the approximate 16 mile shoreline. Hopefully this is only the beginning of additional studies in and around Phelps Lake. One can only wonder what additional knowledge can be gleaned from a setting so abundant in archaeological treasures.

REFERENCE

EGLOFF, KEITH T. and POTTER, STEPHEN R.
1982 Indian Ceramics from Coastal Plain Virginia, Archaeology of Eastern North America, Vol 10

LESLIE S. BRIGHT
UNDERWATER ARCHAEOLOGY UNIT
DIVISION OF ARCHIVES AND HISTORY
P.O. BOX 58
KURE BEACH, NORTH CAROLINA 28449

S. DOMINIC RUEGG, F.S.C

Analysis of the Artifacts of the Garigliano River, Italy, Daily Life and Work

By comparing the excavation reports of Roman sites in Britain, Southern Germany, and France with those of Italy there is, generally speaking, a noticeable difference. In Italy there is an obvious lack in the number of studies of artifacts which shed light on the daily life of the full population. An Italophile might well remark: "But why should we? We have Rome, Pompei, and Herculaneum; and they, i.e. the Western Europeans aside from southern France, have but the scraps of Roman occupation." In Italy much has been meticulously studied, for example Roman public buildings (v.g. the fora, temples, and theatre at Minturnae) (Johnson 1935: I; de' Spagnolis 1981), imperial palaces, villas and tombs of the wealthy and powerful, and statuary (v.g. the statues found at Minturnae, some in the antiquarium there and others in Zagreb) (Harnett 1986). But on the other hand the storerooms of many museums in Italy have countless bins of unstudied artifacts of daily life. The object of this paper is to analyze some of the minor artifacts found in the Garigliano River, Italy and to draw a few conclusions from these on some of the industrial activities of the general population in the Roman provincial town of Minturnae, which is situated 150 kilometers - south of Rome. This paper will deal with only three of the industries of Minturnae: 1., terracotta votives; 2. iron manufacture; and 3. jewelry and personal adornments.

There is one problem in dealing with the artifacts from Minturnae. Its decumanus, or main street, was the Via Appia. Not only the citizens of the city, but civilians and soldiers from near and distant parts passed through the town and over the wooden bridge that spanned the river. The artifacts have been found downstream for 200 m. from the site of the bridge and the area is known as FG 1 (FG = Fiume Garigliano) (Ruegg 1983). It is sometimes difficult to tell whether they are the debris from the town or votives thrown by passersby into the river in honor of the local goddess, Marcia. This may not be a real problem, because the ordinary objects used in daily life seem to be fairly common throughout the Roman world.

The terracotta dedicatory and votive offerings belong to a type that is localized in the towns from Etruria north of Rome to south of Naples. Many examples exist in the museums of Capua and Naples, similar to the ones found in the Garigliano (Comella 1981; Fenelli 1975). Originally these artifacts were painted. The ones from FG 1 were all found within a 30 meter area and most are broken, as if debris was cleared out of a nearby temple and thrown into the river. A female head of a dedicatory statue shows some Hellenistic influence and can be dated not earlier than the 1st century B.C. (Bonghi Jovino 1965: 70, head J Ial). There are numerous fragments of small statuettes, and they have also been found at the temple of the local goddess, Marica (Mingazzini 1933), which is more than a kilometer

downstream from FG 1. Others concern fertility, such as scrota, uteri, and babes in swaddling clothes. The most numerous remains are of the lower half of a male torso: broken feet, legs, and thighs. There is only one that is nearly complete. It is crudely made, but it still has the remains of its original paint: white between the legs and red on the legs. There are four types, examples of which exist in the storerooms of the Museo Nazionale, Naples: first, like the one found in the Garigliano, with the backing from the feet to the buttocks; the second type with the backing from the middle of the calves to the buttocks; the third with the backing from the feet to the middle of the thighs; and the fourth type which is free standing and generally quite skillfully modeled. The only evidence for local manufacture of these votives is a mold for a hollow female head. There are several examples of fired pieces with full frontal face, showing a part of the coiffure under a heavy capuche-like veil which extends down below the neck; the backs of the head are sketchily done or nonexistent. All these votives were so common in Central Italy during the Republic that they were probably fashioned and fired in local workshops.

The second group of objects concerns the iron industry of Minturnae. In the Garigliano were found two pigs of iron and more important some pieces of hematite, a very high grade of iron ore. This was probably imported from the island of Elba in Tuscany and later perhaps from Spain (Forbes 1964: 102, 175-276; Tylecote 1976: 53-58). There is quite a range of iron artifacts, such as spikes and nails, hundreds of which were recovered around the first pier of the bridge. Some are clenched and one has a lead covering over the head and part of the shaft, and may have been used in ship building. There are iron hooks, one of which is similar to a boat hook found in Belgium (du Plat Taylor and Cleere 1978: 28). In addition there are iron knives, cotter pins, needles, spindle hooks, handles, hinges, etc.

Since there is such a variety of iron artifacts, it might be asked how did Minturnae become a provincial locale for iron manufacture? The earliest reference comes from the times of the Punic Wars when the city of "Populonia (the coastal city opposite the island of Elba) furnished iron for the levy in 205 B.C. for Scipio's invasion of Africa. During the war period from 200 to 150 B.C. the manufacture of arms was quite extensive in the towns between Rome and Capua," (Forbes 1964: 264) of which Minturnae was one of the more prominent. There is a small pair of iron tongs, which once had wooden handles, and was used in iron working (Gaitzak 1980: I, 229-30; II, nos. 86-88; Mingazzini 1933: 915). In addition the Vescian Plain around Minturnae was intensively cultivated and many iron implements and tools were in demand. Cato in his De Agri Cultura (135, 1), written about 150 B.C., mentions nine kinds of tools for his olive orchard that he could purchase at Minturnae. A pick, a mattock, and a hoe have been found in the Garigliano.

Other interesting iron finds are the shoes at the foot of the more than 120 oak piles which form the first pier of the wooden bridge, built originally in the second half of third century B.C. and in use until the destruction of Minturnae sometime in the late fifth or early sixth century A.D. (Ruegg 1983). The eight iron shoes retrieved are of similar construction: four flat pieces of wrought iron, each about 40 centimeters long. The lower half was hammer-welded and shaped to a point; the upper half of the four flat pieces was spread out and became the arms, which were then attached by iron nails to the tapered end of the oak pile (Campbell and Fahey 1984). The iron was most probably smelted and made into flat pieces of the required length at Minturnae. Similar iron shoes have been fund on Roman bridges in Yugoslavia, southern Germany, France, and England (Cuppers 1969: 47-49, 173-202). With three of the iron shoes were found foundation coins either hammered on or securely placed between the pile and the shoe: one each from the time of the Emperors Claudius, Hadrian, and Maximianus, from the 1st century to end of the second A.D.

he third section of this paper has to do with jewelry and more mundane personal adornments. Very few objects in gold were found, and even less in silver. The only complete artifact in gold was a necklace with 31 rectangular links interspersed with 3 ellipses enclosing an S. Some, in part similar, were found in Britain (Marshall 1911: nos. 2705 and 2712). The remaining pieces are three gold rings and bits of earrings, bracelets, and necklaces. This jewelery, as well as others in lesser metals, could have come from the cemetery upstream, still unexcavated, but part of which has collapsed into a large, relatively recently formed bend in the river. This is unlikely as there is no other funerary evidence in FG 1. The more likely explanation is that the gold artifacts were votive offerings thrown from the bridge. Is it possible that wealthy citizens, who had a strong devotion to their local goddess, were more likely to throw in valuable pieces of jewelry than strangers? It cannot be known whether these objects came from more distant parts, for example from Rome. But since similar fine jewelry was worn by the upper classes throughout the Roman world, styles tended to be copied by skilled local craftsmen, as the presence of remains of small pan balances and jewelers' weights in FG 1 may indicate.

Yet the paucity of gold artifacts, plus the fact that there were less than 100 silver coins among the 5000 Roman coins recovered, and that there are thousands of artifacts in the baser metals seems to say that Minturnae was not a conspiciously wealthy city, but rather that most of the population were very ordinary folk. They wore quite inexpensive jewelry in lead, bronze, and iron, such as rings and pendants. Fibulae or brooches of bronze are of a number of types, but the one of interest are some brooches of the Nauheim type which are made of one piece of wire. These are from the 1st century B.C. and have many parallels from the military camps of Spain and Britain, but especially of the Rhineland (Ulbert 1959: pl. 14; 1969: 34; 1984 pl. 7; Crummy 1983: 7-8; Allason-Jones and Miket 1984: 3.14-15). In the same areas brooches which represent a cock or pigeon, like ones from the Garigliano, have been found (Alvarez-Ossorio 1941: pl. CLXIV; Hawkes and Hull 1947: pl. 98; Walke pl. 95). A brooch that may be an import is one of lead or pewter, decorated with three fish. The only similar design is on two pewter spoons in the Museum of London (Walbrook no. 1919 and MoL no. 84.453/2) and all three were probably manufactured in England.

There are two types of phallic amulets in bronze and both types were recovered in the Garigliano: one is simply the male genitals (Allason-Jones and Miket 1984: 3.586-7) and in the second the male genital is balanced by a right arm (Feugere 1981: 142-44). This kind of amulet in a stylized way resembles the horns of a bull. There are some examples in southern France which have a bull's head in the center in place of the scrotum. At the end of the arm is an outstretched hand or a clenched fist with the thumb protruding between the index and middle finger, making the gesture "de la fica," to us a time-honored obscenity. Yet there is no reason to believe that it had any such meaning in antiquity. These amulets were worn by men and connected in a general way with the notions of masculinity, life, fertility, but above all they were simply a symbol of good luck and to ward off the Evil Eye (just as similar amulets are used in Italy today). On the other hand there is no good reason to preclude their use in civilian life. These amulets have been found in France and Italy, but primarily in military camps on the Rhine and in Britain (Ulbert 1969: 47; Green 1978: 34). They were generally worn as a single ornament on a necklace, but also could be suspended from a belt or harness.

There are a number of other items that can be associated with soldiers. Button and loop fasteners, consisting of a simple ring with a shaft and a transverse bar (Wilde 1970: IX) or with a trianglar fastener (Wild 1970: Va) are associated with military cloaks of the 2nd and 3rd centuries A.D. and bronze handles that were attached to helmets as a carrying device (Hawkes and Hull 1947: pl. 99). There are many common types of buckles, sometimes used as harness fittings, and many have military parallels (Ulbert 1959: pl. 17; 1969: 39, 45; 1984: pl. 10).

In this section on personal decorations in bronze I have stressed the presence of soldiers at Minturnae. This has been hitherto undetected and belies the few weapons found in the Garigliano, to date only 1 iron spear head and 3 lead sling bullets. Probably most of the soldiers passed through the town either to or from the eastern Mediterranean; but from its founding in the 3rd century B.C. as a castrum, or military camp, there was always a military presence. During its apogee in the 2nd and 1st centuries B.C. Minturnae was fortified with a high wall and 24 towers. The Emperor Augustus settled a contingent of his veterans from the battle of Actium at Minturnae in 28-27 B.C. But why are the majority of the parallels of ordinary personal adornments from the military camps of Spain, Britain, and especially the Rhineland? Soldiers from Italy, just like American soldiers today, brought with them to their camps in faraway lands a bit of home, various aspects and articles of their Mediterranean culture. Incidentally this notion of romanitas., i.e. the spreading of Roman culture, was forceably demonstrated at the December 1986 meeting of the Archaeological Institute of America in San Antonio, Texas in a session dealing with Roman trade with India. Two speakers, H. Comfort and E. L. Will, talked about two types of Roman ceramics found in India and the best parallels for them, aside from Italy, came from Britain and the Rhineland.

On the other hand these artifacts under discussion are not necessarily restricted to military personnel and they probably indicate a lively bronze industry in small objects at Minturnae. Although no copper, tin, or bronze ingots were found in the Garigliano, much scrap bronze was, such as fragments of bronze statues, used furniture fittings, left-overs from castings, broken bronze nails, etc. It was customary to sell scrap bronze by weight, ready to be recycled to make many small objects such as keys and bolts for locks, medical or cosmetic instruments, awls, washers, rivets, bosses, furniture tacks, needles, etc.

In this paper I have discussed only three local industries. There is archaeological evidence for many other industrial and commercial activities, such as the building trades, ceramics, lamps, textiles, etc. In another article (Ruegg 1987) I have written about other industries at Minturnae that relate to fishing and trade, such as the production of garum, or fish-sauce, and the trade in salt and pitch; the presence of merchants from Greece and the Near East; the exports of Campanian Black Glaze pottery and of Greco-Italic amphoras filled with the famous wines of the area, Falernum and Massicum; the importing of bulk products such as marble, copper, and lead; and shipbuilding. Yet the maritime industries and trade by ship must not be overemphasized. No doubt the river-harbor contributed to the life of the city, and merchants and middleman did make a living and contribute to the living of others. Yet Minturnae, like all Roman provincial towns, was primarily concerned with those industries that took care of local requirements, especially those regarding agriculture, because land, not trade by sea, was always the safest and most sought-after investment. Even though there is evidence for a large presence of the military, it was the civilian population of the town, both freedmen and slaves backed by the wealthy landowners, who produced all their own needs and for most of these items comparative material exists throughout the Roman world.

REFERENCES

ALLASON-JONES, LINDSAY and MIKET, ROGER
1984 *The Catalogue of Small Finds from South Shields Roman Fort.* The Society of Antiquaries of Newcastle upon Tyne.

ALVAREZ-OSSORIO, F.
1941 *Catalogo de Los Excotos de Bronce*, Ibericos. Madrid.

BONGHI JOVINO, M
1965 Capua Preromana, *Terracotte Votive I.* Firenze

CAMPBELL, JOHN and FAHEY, FRANK
1984 A Metallurgical Study of Iron Shoes from the Piles of the Roman Bridge at Minturnae. *Journal of the Historical Metallurgy Society 18: 21-30.*

COMELLA, A.
1981 Tipologiia e Diffusione del Complessi Votive in Italia in Epoca Medio- e Tardo-Republicana. *Me lange d'Archeologie et d'Histoire 93: 7 59-766.*

CRUMMY, NINA
1983 *The Roman small finds from excavations in Colchester 1971-9.* Colchester Archaeological Trust Ltd., Colchester.

CUPPERS, H.
1969 *Die Trierer Romerbrucker.* Mainz

de'SPAGNOLIS, MARISA
1981 Minturno. *Edizioni di Odisseo*, Itri, Italy.

du PLAT TAYLOR, JOAN and CLEERE, HENRY
1978 *Roman shipping and trade: Britain and the Rhine Provinces. Research Report No. 24.* The Council of British Archaeology, London

FENELLI, M.
1975 Contribute per lo studio del votivo anatomico. *Archaeologia Classica XXVII: 248.*

FEUGERE, MICHEL
1981 Decouvertes au quartier de Villeneuve, Frejus (Var): mobilier metallique et al parure.*Documents d 'Archeologie Meridionale IV: 137-168.*

FORBES, R.J.
1964 *Studies in Ancient Technology* IX. Leiden.

GAITZAK, W.
1980 *Eiserne Romische Werkeuge I and II.* Oxford.

GREEN, M.J.
1978 *A Corpus of Small Cult-Objects from the Military Areas of Roman Britain*, Oxford.

HARNETT, ERIKA
1986 *The Sculptures of Minturnae.* Doctoral Dissertation. Bryn Mawr College, Bryn Mawr, Pennsylvania.

HAWKES, C.F.C. and HULL, H.R.
1947 *Camuludonum. Report of Research Committee of the Society of Antiquaries of London XIV*, London.

JOHNSON, JOTHAM
1933 *Excavations at Minturnae II.* University Museum at the University of Pennsylvania, Rome.

1935 *Excavations at Minturnae I.* University Museum at the University of Pennsylvania, Philadelphia.

MARSHALL, F.H.
1911 *Catalogue of the Jewellery, Greek, Etruscan, and Roman of the British Museum.* London.

MINGAZZINI, P.
1933 Il Santuario della Dea Marica alle Foci del Garigliano. *Monumenti Antichi* XXXVII: 694-933.

RUEGG, S. DOMINIC
1983 The Underwater Excavation in the Garigliano River: final report 1982. The Roman port and bridge at Minturnae, Italy. *The International Journal of Nautical Archaeology and Underwater Exploration* 12: 203-218.

1987 Minturnae: a Roman River Sea-Port on the Garigliano River, Italy. *Archaeology and Coastal Change*, Haifa (in press).

TYLECOTE, R.F.
1976 *A History of Metallurgy*. London.

ULBERT, G.
1959 *Die Romischen Donau-Kastelle Aislungun und Burghofe*. Berlin.

1969 *Das Fruhromische Kastell Rheingonehim*. Berlin.

1984 *Caceres el Viejo*. Mainz.

WILD, J.P.
1970 Button and Loop Fasteners in the Roman Provinces. *Britannia* I: 137-55.

BRO. S. DOMINIC RUEGG, F.S.C.
P.O. BOX 141
SAINT MARY'S COLLEGE
MORAGA, CA 94575

JOHN CARTER
JAMES COVILL
WILLIS STEVENS
ROBERT GRENIER

A Feasibility Study of a Diver Operated Computer and Data Acquisition System Designed for Underwater Archaeology

Introduction

Underwater archaeologists routinely record information using a combination of photography and pencil notations on paper. Although archaeologists are comfortable with this methodology, it is limited in that it is not possible to produce organized and legible notes under all conditions, and the data are not amenable to three dimensional interpretation in the field. Recording the data in a computer format in the first place would be a significant improvement. This has been recognized by land archaeologists (Stephen and Craig, 1984), but until now the approach has not been developed for underwater archaeology.

In an effort to improve underwater data recording, Martec Limited developed a diver-operated computer (called SUB-C-DAS) which is programmed to prompt the diver for specific entries and to store the data for subsequent transfer to a larger computer on the surface. The system has been adapted for underwater archaeology and includes mapping and graphics programs for recording and viewing the data.

Under contract to the Marine Archaeology Unit of Environment Canada - Parks, the feasibility of SUB-C-DAS as an underwater archaeology tool has been examined. The purpose of this paper is to describe the basic components of the diver-operated computer and to outline the initial results of the feasibility study.

Materials and Methods

The submersible part of SUB-C-DAS is shown in Figure 1. It comprises a Hewlett Packard (HP) 41CX programmable calculator with 6.4 kilobytes memory in a housing, an optical wand connected to a fiber optic cable outside the housing, a light-emitting diode indicating correct entries, and a bar code "keyboard" simulating the alpha-numeric characters and functions of a conventional computer keyboard. A diver responds to prompts on the display by making measurements within a grid and enters the data by scanning the appropriate bar code. The data are shown on the display and the program is advanced. The computer is battery-powered and can be held comfortably in the diver's hand or mounted on the wrist.

The data in the diver-operated computer can be printed on a thermal printer as soon as the diver surfaces and then can be streamed to a microcomputer and plotter via an RS232C interface. The latter are powered in the field by a small generator.

For the feasibility study, SUB-C-DAS was programmed to prompt for and read individual artifact labels and x, y, and z coordinates of critical positions on each artifact, the latter being determined by the diver using a grid, crossbar and plumb bob. Up to 200 measurements points could be stored before memory limits were exceeded. A diver could also make comments to the file, if additional information was required. A program was written to manage and plot the data with an IBM PC. The program is fully menu driven to facilitate its use by a novice computer user. The data base branch of the program allows the user to select a file for plotting, to combine files, to list the files, and to read data files from SUB-C-DAS via the serial port. The graphics branch permits the generation of 2D and 3D plots, selective plotting of artifacts, and variable scaling. The 3D images can be rotated in the xy and yz planes. A viewing distance factor was also incorporated, affecting the degree of perspective effect. With 3D plots, the viewpoint is centered at the middle of the volume of interest, yielding a plot which resembles what the diver sees.

Two SUB-C-DAS units and the software were evaluated in October 1986. These included the prototype unit and Mark II (Figure

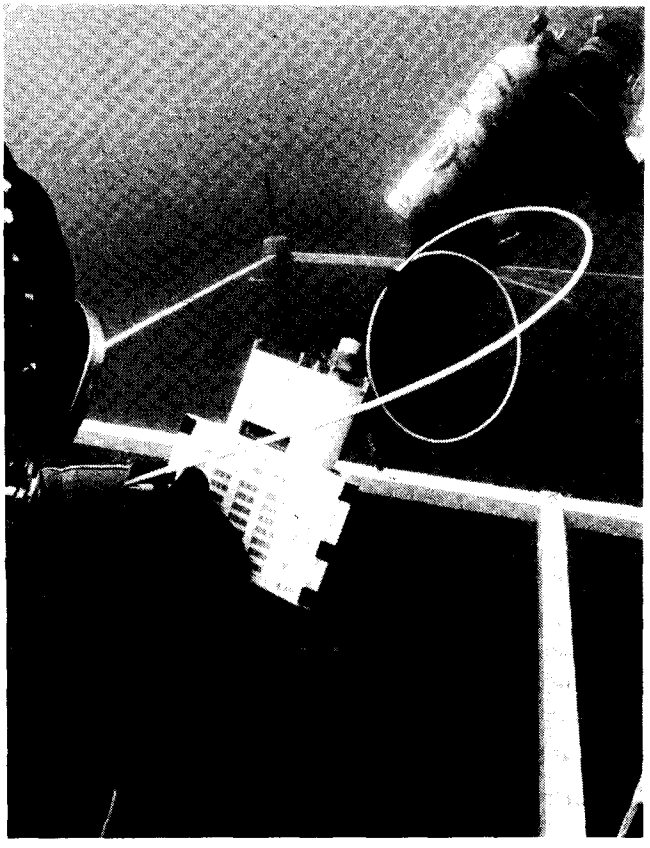


FIGURE 1. The diver-operated computer (SUB-C-DAS)

1), which was an improved version of the prototype. The work was conducted on the wreck site of an eighteenth century French warship in Louisbourg Harbour, Nova Scotia, on the east coast of Canada. Water depth at the site was 8 meters. Water temperatures during the test was 10 degrees C.

Mapping was confined to 8 square meters in the mast and pump well area of the wreck (Figure 2), an area which had been mapped by conventional methods during the summer of 1986. Divers mapped only obvious ship structure and artifacts within the two suboperations 28N and 30N. Each object was defined as a facet, with the diver determining the x, y, and z coordinates of points on the periphery of the facet in a clockwise manner.

The parameters that were examined during the feasibility study included the ergonomics of SUB-C-DAS operation, data entry rate, the error rate, and the effectiveness of the software.

Results and Discussion

The divers had no particular difficulty in holding the computer in one hand and using the fiber optic scanner in the other hand, since this operation was similar to pencil notation on a slate. Mitts were not an impediment to use of SUB-C-DAS, although the grip on the scanner must be optimized for mitt operation. Low water temperatures, suspended particles in the water, and incident light did not interfere with operation of the computer. The display was clearly visible when the diver held SUB-C-DAS in his hand. The light-emitting diode indicating character entry was also visible, but the divers tended to check the display for correct data entry, rather than relying solely on the LED.

An extra memory module was necessary for the more productive divers (those who could enter more than 40 sets of x, y, and z

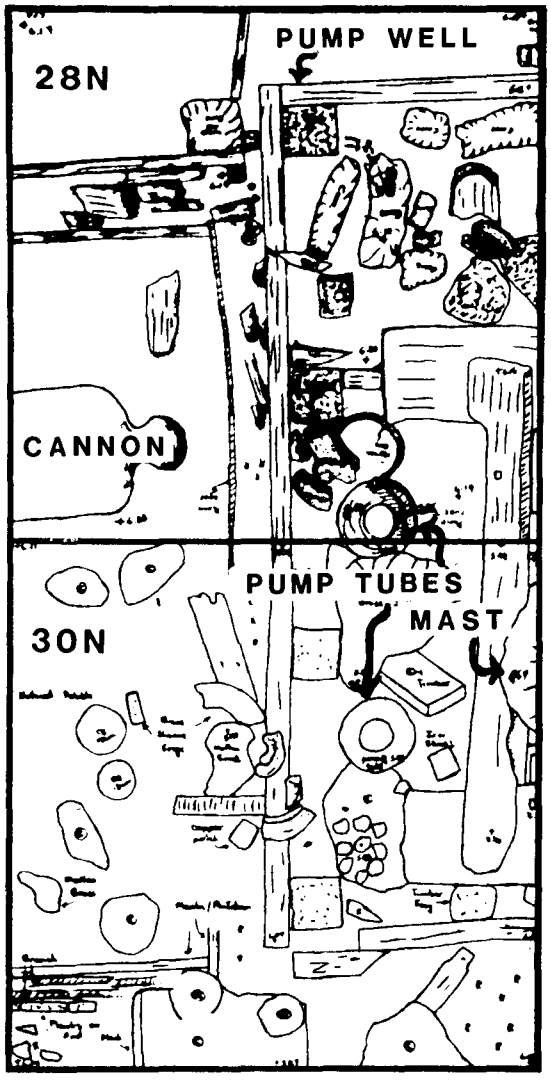


FIGURE 2. Gridded area of Louisbourg wreck in which mapping with SUB-C—DAS was conducted (2 x 4 meters).

measurements in one dive). It was felt that one extra memory module was adequate for most divers. It was important to monitor the use of the batteries. A good set of 1.5 volt alkaline batteries was sufficient for at least several dives. However, there was difficulty in reading the bar codes when the batteries were drained to about 1.2 volts. This problem is easily avoided by daily replacement of batteries.

Technique with the fiber optic scanner was found to be important in correctly entering characters in a single pass of the bar code. A novice user initially had some difficulty in coordinating use of the scanner, especially on bar codes in the corner of the keyboard. A diver with only an hour's experience with SUB-C-DAS generally had no technique problems (in fact, reorganization of the keyboard and slight changes to the scanner have since eliminated all technique problems). Data entry with SUB-C-DAS generally requires the same amount of less time than writing underwater for the equivalent character entry.

Table 1 summarizes the data output from the SUB-C-DAS test in Louisbourg Harbour. The duration of mapping on individual dives ranges from 45 to 95 minutes. The number of objects mapped per dive ranged from 6 to 12, with an average number of measurement points from 4.0 to 6.3. The percentage of correct data entries for a diver experienced with SUB-C-DAS ranged from 91.8% to 100%, the higher rates (98.3%-100%) being achieved with the improved model (Mark II). The raw data from these dives required minimal editing and the graphics could be produced within minutes of the end of the dive. The most consistent rate of correct measurement points for the diver experienced with the computer was about 0.81 per minute. The divers who were inexperienced with SUB-C-DAS has a lower rate of correct data entry compared to the experienced diver. The lowest rate was 40% for one diver. The other diver was consistent at about 69%. Because these divers made more mistakes entering data, their productivity was decreased, ranging from 0.29 to 0.49 correct measurement points per minute. It was felt that if the divers had been more familiar with the software and error correction underwater, their productivity would have been higher.

An important observation during the field trials was that the most time-consuming task the diver faced was manipulating the grid, not using the computer. Placing the crossbar and plumb bob accurately over the measurement point took up to 85% of the diver's time, with only 15% being required for data entry. It was clear that a much better grid compatible with the use of SUB-C-DAS could be designed, perhaps tripling the data entry rate.

One of the major differences, from the diver's point of view, between conventional mapping and using a SUB-C-DAS was the lack of a visual record which the diver could refer to in the case of the computer. A diver had to remember which objects he had already mapped and also the first measurement point of the object he was currently working on. The former was not a significant problem as divers tended to work through a grid area in a logical manner, but there were a few cases in which the diver forgot the first measurement point of an object and the graphics program plotted the object incorrectly. The simplest solution to this problem is to tag the starting point for each object.

The amount of time spent with the computer in each grid was slightly less than the time required for conventional mapping. However, fewer objects were mapped using SUB-C-DAS. There was fairly good agreement between the two mapping methods when regular-shaped objects were compared (e.g. rectangular planks). There was less agreement when curved or circular objects were compared. The main problem in this case was the requirement for many measurement points to approximate curved and circular peripheries of objects, and the divers usually did not plot enough points to accurately show these types of objects. This problem can be corrected in the software. For example, a diver can code an object as a circle and just measure the center and a point on the circumference. The plotting program would then plot a complete circle. Irregular-shaped objects would require more creative software. Perhaps concretions could just be coded by the diver and shown as symbols on the plot.

The most useful feature of the computer plots is the ability to rotate and view the vertical axis of features in the grid. This is not

Diver	Duration of Mapping (Minutes)	No. of Objects Mapped	Average No. of Measurement Points Per Objects	Total No. of Lines of Data	% of Lines Correct for Graphics	No. of Correct Measurement Points per Minute
1 (experienced with SUB-C-DAS)	55	7	4.3	30	100%	0.55
1	70	10	5.6	58	98.3%	0.81
2 (novice)	75	6	4.0	33	69.7%	0.31
2	80	6	6.3	57	68.4%	0.49
1	50	9	4.6	41	100%	0.82
1	45	10	4.4	45	97.8%	0.98
1	70	12	4.7	61	91.8%	0.80
3 (novice)	95	7	4.0	70	40.0%	0.29

TABLE 1. Summary of Sub-C-Das operations in Louisbourg Harbour

possible with conventional plots, especially in the field. The usefulness of the ability to view and rotate an image is more apparent at sites with strong vertical relief and where there is the original continuity between structural elements of a ship. Examples from an eighteenth century schooner wreck are shown in Figures 3 and 4. These plots are useful in interpreting the curvature of the ship's hull, especially when hidden lines can be removed from the plot to clarify the image (the software is currently being developed to do this). A significant advantage of SUB-C-DAS plotting over conventional mapping is the storage of x, y, and z coordinates in the database. With conventional mapping, the diver determines the x, y, and z coordinates visually and draws the appropriate points and lines, but does not retain real numbers in the data record. With SUB-C-DAS plotting, these values are retained and in fact the dimensions of objects can be accurately determined from the database once the coordinates have been entered.

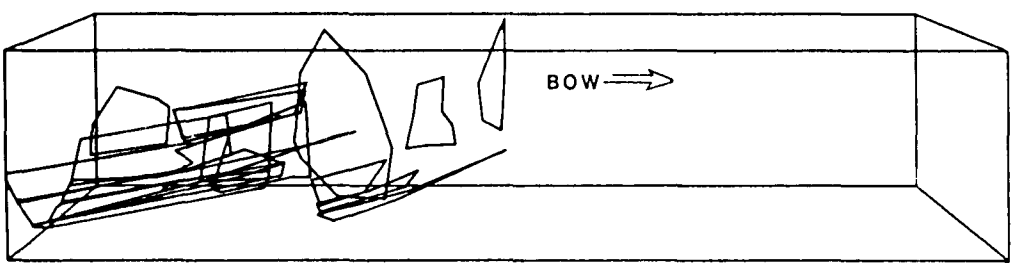


FIGURE 3. Example of computer-generated data from a schooner wreck.

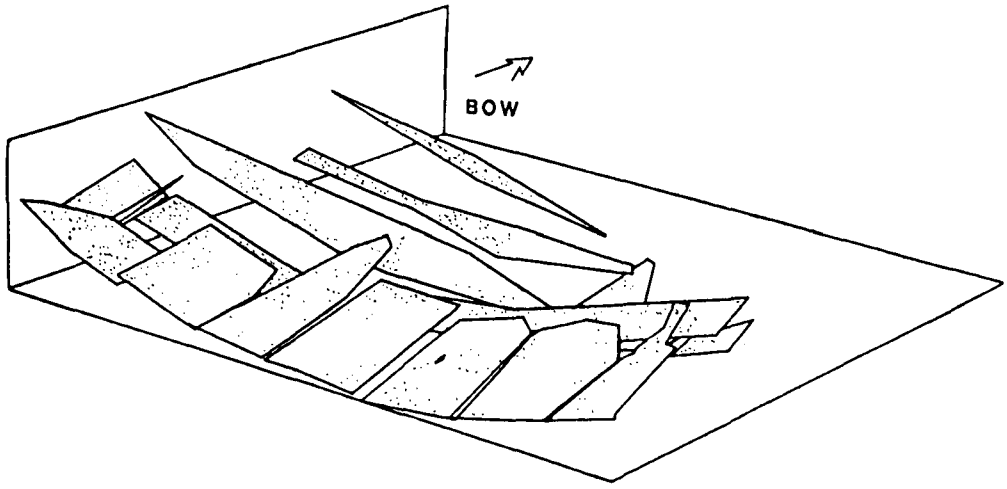


FIGURE 4. Oblique view of the data in Figure 3 with hidden lines removed.

Conclusion

Although the computer plots generated by data recording with SUB-C-DAS lack the realism provided by conventional mapping and photography, they do provide significant advantages over conventional plots, especially for sites with ship structure remaining. The ability to display and rotate the vertical component of a site within minutes of a dive should allow better site interpretation in the field. The diver-operated computer cannot completely replace conventional methods of underwater archaeology data recording, but it can be a useful tool on most sites, especially as the software is developed to optimize diver use and data plotting.

Acknowledgements

This study was funded by Environment Canada - Parks and Supply and Services Canada. Diving assistance and photography were provided by Gordon Murray and Denis Pagé. We thank Tanya Reynolds for typing the manuscript.

JOHN CARTER, JAMES COVILL
MARTEC LIMITED
5670 SPRING GARDEN ROAD
HALIFAX, NOVA SCOTIA
CANADA, B3J 1H6

WILLIS STEVENS, ROBERT GRENIER
MARINE ARCHAEOLOGY UNIT
ENVIRONMENT CANADA - PARKS
1600 LIVERPOOL COURT
OTTAWA, ONTARIO
CANADA, K1A 1G2

REFERENCES

STEPHEN, D.V.M. AND D.B. CRAIG
1984 Recovering the Past Bit by Bit with Microcomputers. *Archaeology 37*: 20-26.

LARS EINARSSON

HMS *KRONAN*: Underwater Archaeological Investigations of a 17th Century Man of War

The Kalmar Region - The Cradle of Swedish Maritime Archaeology

The Kalmar-region, in the south-east part of Sweden, has a long marine-archaeological tradition. Two of the first marine archaeological investigations ever performed in Sweden were done here in the early 1930's; Mr. Carl Ekmans investigations of the Swedish 16th century man of war *"Elefanten "*- "The Elephant" - and Mr. Harald Akerlunds investigations of the Kalmar castle moat. Here remains of no less than twenty-five boats from medieval time to the 17th century, were found.

In our days this tradition lives on with the underwater archaeological investigations of HMS *Kronan* - The Royal Crown - lost in battle June 1st 1676. The Kronan-investigations are the largest of its kind since the salvaging of the *Vasa* in the 1960's. The Kronan project is supervised by the Kalmar County Museum. The investigations started in 1981.

Kronan's keel was laid 1625, and the ship was launched in 1668. It took four more years until 1672 until the ship was taken into service, this due to financial problems, which delayed the equipping of the ship.

Kronan is Built

Kronan was built in the English shipbuilding manner by Francis Sheldon who introduced the manner in Sweden. Sheldon was employed by the Swedish King, Carolus X. *Kronan* was the first three decked ship ever built in Sweden, and she carried 126 cannons. The displacement was 2,140 metric tons. The length was 178 1/2 feet, the breadth 43 5/12 feet. At the time of her disaster the crew consisted of approximately 850 men.

Historical Background

When King Carolus XI of Sweden came of age in 1672, the economy of the country was in a poor state. The regency of nobility, who had ruled the country between 1660 and 1672, had administered the economical assets irresponsibly. Thus, the Swedish navy was in a terrible condition.

In 1675 a talented administrator, Barron Lorentz Creutz, was appointed General Admiral by the King. He was to bring order back into the Swedish Navy. The reaction against Creutz' appointment was very strong among the Navy Officers because of his lack of sea-experience.

In the mid 1600's, Sweden was a great power. The general strategic ambition of the state, was to control the Baltic sea and the shores around it, thus creating a closed inner sea - a "Mare Claustrum".

In 1675 the Swedish provinces on the European continent was attacked by Brandenburg. The same year Denmark declared war on Sweden, seeing their chance to restore the Old Kingdom, partly lost 17 years earlier.

In the Spring of 1676, the Swedish navy set sail for the southern Baltic. The mission was to search and destroy the Danish fleet which was ravaging the Swedish islands.

The first battle between the enemy fleets was fought between the islands of Bornholm and Rugen, at night the 25th of May. In spite of the Swedish superiority in number, the Danes escaped, and were a few days later joined by a Dutch squadron the command of Cornelis Tromp. The Dutch became a Danish ally in order to prevent Sweden from gaining total control of the Baltic.

The Swedes had acted in confusion during the battle. Therefore the King ordered the fleet to seek battle closer to the Swedish mainland, thus preventing a possible disaster, by being able to seek refuge in Swedish ports.

The Great Naval Battle

In the morning of June 1st 1676, the Swedish fleet consisting of more than 60 ships, sailed northwards in a southwestern gale, along the southeast coast of the island Oland. Outside the village Hulterstad, the admiral's ship of the second squadron - *Svandets* (The Royal Sword) - fired a gunshot. The purpose of the shot was either to call the fleet closer together, or a request to turned against the enemy, who were closing up from behind. Without answering *Svardets* shot, *Kronan* turned with the wind without taking in the sails. Suddenly the ship heeled over, and started to capsize. The crew desparately tried to pull in the guns through the gunports, but all in vain. The ship capsized and was shortly after shaken by an explosion and the starboard side was blown to pieces. *Kronan* sank rapidly. Only 40 men survived the disaster. Eight hundred men died within a few minutes. Among them admiral Creutz. *Kronan's* wreck caused total confusion in the Swedish fleet. Only a few ships remained to continue the battle, among them *Svardet*. *Svardet* fought heroically, but after a few hours the ship was put on fire by a Dutch fireship. The result of the battle was disastrous; the two largest ships in the Swedish navy and 1,500 sea men were lost. The effects of the damages caused to the Swedish navy lasted for decades.

Searching for *Kronan*

In the 1950's, Mr. Anders Franzen established a wrecksearch-program consisting of twelve Swedish men of war from the 16th and 17th centuries lost in the Baltic sea. Mr. Franzen had fully realized the marine archaeological consequence of the lack of Teredo Navalis - the shipworm - in the Baltic, due to its low salinity, thus making the sea an underwater-archaeological treasure-chamber.

In 1956, Mr. Franzen managed to discover the *Vasa* in the waters of central Stockholm. He had also sporadically looked for *Kronan* over a couple of decades. In 1979, Mr. Franzen, together with three skilled engineers with underwater archaeological experience, started a systematic survey outside the east-coast of Oland, in order to locate *Kronan*. Thirty-five square kilometers were searched with side scan sonar, proton magnetometer and low light television. But *Kronan* was not found.

In 1980, the team concentrated their searchwork in a "hot" area outside the village of Hulterstad. On August 8th *Kronan* was discovered 3.2 nautical miles off the east coast of Oland, at a depth of 26 meters. The first sight that met the divers, was one of a broken down wreck, not a *Vasa*. But the sediments of the wrecksite would later prove to contain thousands of artifacts, originally belonging to the numerous crew, which represent a 17th century in miniature which was capsuled and deep frozen at noon June 1st 1676.

The historic-cultural interest in *Kronan* can be explained if it is compared to the *Vasa* (1628). *Vasa* was not fully equipped when it sank. The crew consisted of a relatively small number of people.

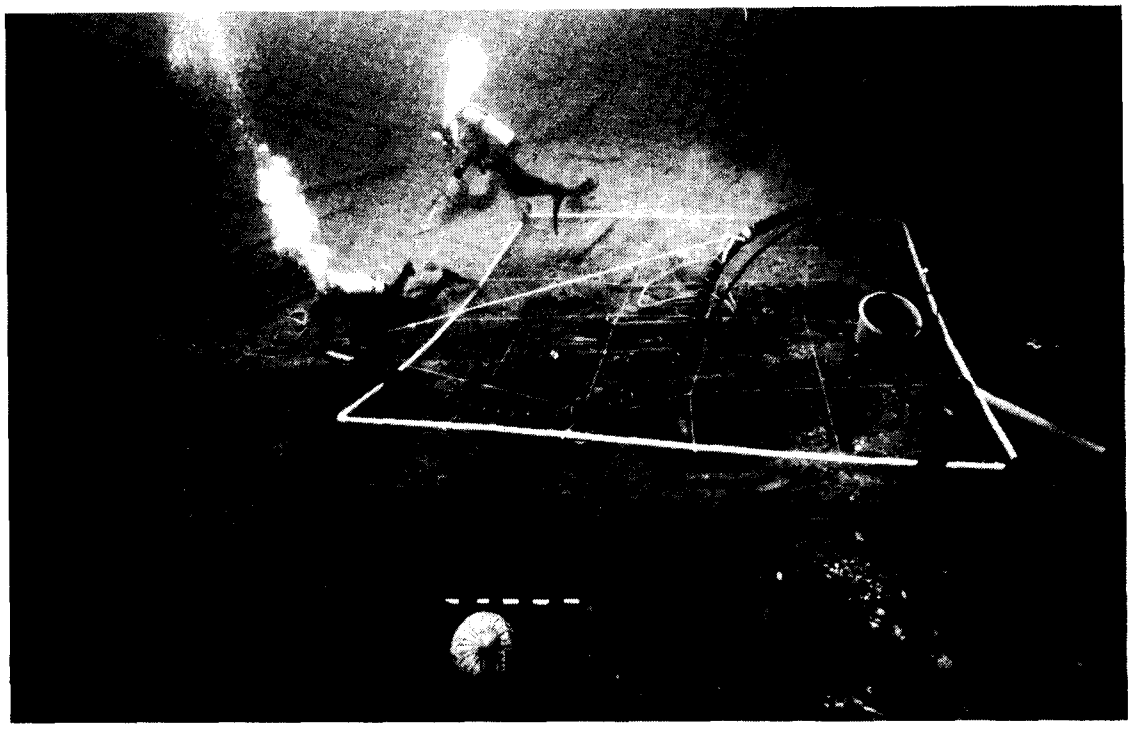


FIGURE 1. Continuous, systematic excavations, proceeding from the flat lying portside started in 1984. Some cannons still rest in their gunports. (Photo: Nils Aukan/Kalmar County Museum).

FIGURE 2. In-situ findings of internal wooden sculptures, in a remarkably good state of preservation, have been made on the port side of *Kronan*. (Photo: Jonas Ekstromer/Kalmar County Museum).

This together with the extensive salvaging that took place during the years after the wreck resulted in an almost empty ship. The *Kronan*, on the other hand, sank fully equipped for war and with a complete crew.

Underwater Archaeological Investigations

In 1981 the underwater archaeological investigations of *Kronan* started, supervised by the Kalmar County Museum. The museum did not receive any funds from the state for the investigations, and thus had - and still has to - depend on sponsoring from private donators and companies. Important support to the project is also given by institutions like the Coastguard, the Royal Swedish Navy, Kalmar University and the Royal Institute of Technology.

The conditions for making an underwater archaeological investigation on the wreck site of *Kronan* are in many regards extremely good. The vegetation-free light sand bottom contributes to making the visibility good; at best up to 30 meters in horizontal and vertical directions. This makes the choice of method easier. However, the conditions on the surface are worse. The exposed location of the wreck site in the Baltic sea, causes a loss of approximately 30% of the diving time due to unfavorable weather conditions.

Methods and Techniques

The systematic investigations of the seabed around *Kronan* has been confined to an area of forty by fifty metres; its periphery is marked by constructional elements of the ships hull. Surveys of the surroundings of the wrecksite have showed that parts of the wreck are spread out over an area of about one square kilometer. The bottom sediments consist of a thin layer of moraine-sand over a thick layer of homogenous, glacial clay.

The investigated, central area of the wrecksite is divided into twenty squares of ten metres a side. The square comprise a system of coordinates, each corner being marked with a white cross and identified with a letter-number combination. These codes are needed to describe, the location of a recovered objects, while they are also helpful in photographic-and search-work.

A further refinement in excavation is the use of a portable plastic grid, divided into squares (Figure 1). The grid as a whole is fitted into the general system of coordinates before excavations is begun, and then makes the work of describing locations of recovered artifacts easier. This method is used in combination with triangular measuring and has proved to be efficient and motivated at this stage of the excavations.

The actual excavation work is done with an airlift, a sort of underwater vacuum-cleaner; it uses compressed air to draw up the sediment thus revealing objects and parts of the ship construction, without obscuring everything in a cloud of mud. The divers pick up the objects so recovered, while the sediment, sand and gravel drawn up with the compressed air are sieved on deck, so that smaller objects are also recovered.

Important aids in the underwater documentation process are waterproof sketching equipment, underwater cameras, and - perhaps most important - underwater videocamera. Documenting the excavations with low-light video (CCD-system) is a most convenient method of obtaining maximum input of immediate visual information at a relatively low cost. Communication between divers and the surface is obtained by diver telephone.

The divers use only dry-suits, meaning they wear insulating overalls under their diving suit and so remain dry. This prevents the diver from being exposed to the cold waters of the Baltic, which seldom exceeds 8 C at this depth. This is most important with regard to safety.

The diving time at 26 metres depth with compressed air is relatively limited. Each diver does two descents a day, with an effective diving time of 50-70 minutes, depending on if decompression in water is being used.

Starting the excavations in 1981, the first method used, was digging test-shafts in strategic areas of the wrecksite, in order to determine the extension of findlayers and constructional elements of the ship. Immediately, the archaeologists noticed the tremendous amount of artifact preserved in the sediments. Also the exposed parts of the wrecksite showed a remarkable richness of finds. The wood-preserving conditions of the Baltic clearly showed. *Kronan* obviously offers a unique opportunity to make a cross-section of the 17th century society onboard a big battle-ship.

In 1984, after three seasons of excavations, a new method succeeded the test-shafting method. A continuous, systematic excavation, proceeding from identified constructions on the port side started. The choice of method was based upon the knowledge obtained from the previous test-shafting, which led to a theory concerning the deterioration-process and the present state of the wreck. At the time of the disaster, *Kronan* was heading north in a strong southwestern gale. The ship turned with full sails, heeled over on her port side, capsized and turned around in the wind. This is proved by the ships position on the seabed. The great explosion in the powder-storage room, blew the entire starboard side away, since this was the direction of the shock-wave. Probably at this stage, the vessel broke athwart-ships, ahead of the main mast, which explains the absence of the bow. Thus, approximately 2/3 of the length of the port side - from the stern ahead - is preserved. After the explosion, *Kronan* sank rapidly, depending of the lack of floating ability. Reaching the sea floor, *Kronan* immediately rested on the port side. This is indicated by the in-situ findings of internal port side sculptures, originally decorating the walls of the admirals quarters, astern on the upper gundeck. The sculptures were originally nailed to the wall with iron nails, which have rusted away early after the shipwreck. Still the sculptures rest in their original positions.

A consequence of this circumstance must be that also the external sculptures of the port side stern castle, are most likely to be found in their original positions, embedded in the anaerobic, glacial clay. Future excavations will hopefully prove this.

Being the first three-decked ship ever built in Sweden, *Kronan* is likely to show unique constructional details. Some interesting features have already been observed; the inside of the gunports astern on the quarter- and middle gundeck are octagonally shaped. Also rectangular apertures above the gunports on upper gundeck, have been found. Still the outstanding asset of *Kronan* is the tremendous richness of artifacts. Up to 1986 approximately 15% of the area of the wrecksite had been excavated. More than 12,000 artifacts have been salvaged. They represent a wide spectrum of different categories of findings; common utensils, personal belongings, armoury, navigational instruments, sculptures, musical instruments, the largest find of gold coins ever found in Sweden, closed findings like seamans chests, a cabinet and a medical box.

Amoung the most interesting artifacts mentioned above are the wooden sculptures, one of which is shown in Figure. 2. They are in a remarkably good condition. One can still see in detail, how the artist has shaped the piece of wood with his tools. Also, the relatively gentle conservation-process of freeze-drying, makes the original features of the wooden sculptures remain. The possibility of reconstructing the sculptural features of *Kronan*, represents one of the greatest assets of the investigations.

From a social, ethnological and osteological point of view *Kronan's* find contexts give us an opportunity for making a cross-section of 17th century society. Another aspect of underwater-archaeology which illustrates its scientific value is the fact that the conditions for preservation in water, especially in the Baltic sea, are often the opposite of conditions on land (concerning iron and wood, for example). Thus underwater archaeological findings are an excellent complement to findings on land.

The examples mentioned above illustrate the need for integrating maritime and land archaeological research. The importance of the waterways, and their impact on the social, economical and political structure and development of society has been tremendous through the ages. Developments at sea and on land has always been linked together by mutual influence. The distinct borderline which is often drawn at the shoreline in archaeological research, must be erased in order to make us appreciate the entirety which both environments constitute.

International Exchange

A part from the main archaeological purpose of the *Kronan* investigations, there is also a purpose of making the site a melting-pot for international underwater-archaeology. Each year marine-archaeologists from different countries and institutions are invited to participate in the work, in order to exchange experiences and establish relations between different institutions. Baltic wrecks in general, and *Kronan* in particular, offers a unique opportunity for underwater-archaeological work under extremely good conditions.

REFERENCES

AKERLUND, HARALD
1951 *Fartygsfynden fran den forna hamnen i Kalmar.* Uppsala.

CARLSON, STEN and ROSEN, JERKER
1978 *Svensk Historia*, Del 1. Lund.

EINARSSON, LARS and NORMAN, PETER
1982 *Rapport over 1982 ars marinarkeologiska under-sokningar av regalskeppet Kronan.*, Kalmar lans museum.

EINARSSON, LARS
1983 *Rapport over 1983 ars marinarkeologiska under-sokningar av regalskeppet Kronan.*, Kalmar lans museum.

EINARSSON, LARS
1984 *Rapport over 1984 ars marinarkeologiska under-sokningar av regalskeppet Kronan.*, Kalmar lans museum.

EINARSSON, LARS
1985 *Rapport over 1985 ars marinarkeologiska under-sokningar av regalskeppet Kronan.* Kalmar lans museum.

EKMAN, CARL
1934 Sjohistoriska undersokningar vid Bjorkenas. *Sancte Christophers Gilles Chroenica VIII:21-35.* Kalmar.

FRANZEN, ANDERS
1981 H. M. S. *Kronan.* The search for a great 17th century Swedish warship. *Stockholm Papers in History and Philosophy of Technology*, Royal Institute of Technology Library. Stockholm.

HOFFMAN, GABRIELE
1985 Versunkene Welten. Gustav. Lubbe Verlag. Bergisch Gladbach.

INGELMAN-SUNDBERG, CATHERINA
1985 *Marinarkeologi.*, Forlags AB Wiken. Hoganas.

JOHANSSON, BJORN AXEL (Ed.)
1985 *Boken on regalskeppet Kronan.* Bra Bocker. Hoganas.

JOHANSON, LARS UNO
1983 A Traveller's Sundial from the Royal warship Stora Kronan. *Konserveringstekniska studier Rapport T1:109-113.* Stockholm.

JOHANSSON, LARS UNO
1984 A cabinet from the warship Stora Kronan. *Konserverngstekniska studier Rapport T2:77-82.* Stockholm.

KALMAR COUNTY MUSEUM
1986 KRONAN Kalmar County Museums Exhibition. Kalmar.

LANNBY-GOLABIEWSKI, MONICA (Ed.)
1986 Guldskatten fran regalskeppet Kronan. *Kungliga Myntkabinettets katalog* nr 24 Stockholm.

ZETTERSTEN, AXEL
1903 *Svenska Flottans Historia.* Del 1. Norrtalje.

LARS EINARSSON
MARINE ARCHAEOLOGICAL DIRECTOR
THE KALMAR COUNTY MUSEUM,
BOX 104
S-391 21 KALMAR SWEDEN

BENGT GRISELL

Technical Aspects of the Excavation of HMS *KRONAN*

Introduction

I gained my first experience in underwater exploration in 1967, on *Riksnyckeln* that sank in 1628 in the Stockholm archipelago. The wreck was found by chance in 1920 and became badly pillaged. However, due to the shallow water and open sea many heavier objects remained buried below the seabed and were successfully located in 1967.

During the intervening decades the history of the ship was sought in archives, and then documents concerning a different wreck came to light. That wreck was *Vasa*, later located in Stockholm harbour by Anders Franzen in 1961, and today the best known museum object in Stockholm.

These two events lead to the cooperation between Anders Franzen and myself. Since 1973 we have been working together as colleagues at the Royal Institute of Technology in Stockholm, Sweden.

Metal Detector

By tradition, nearly all underwater marine archaeologists in Europe are educated in the arts and humanities, but, in my opinion, relevant problems and their solutions are predominantly technical. As an example, recent progress with the wreck of *Riksnyckeln* came from the use of an underwater metal locater. We used this in 1967 and recovered three bronze cannons, nearly 2000 coins and other interesting objects, all buried in the seabed, sometimes more than one meter down. By doing this we were the first to use an underwater metal detector in Sweden - despite the fact that the metal detector itself was an invention by Graham Bell as early as 1881.

Technical Aids in Search for *Kronan*

When Anders Franzen (responsible for archive research) and I found *Kronan* in 1980, we only succeeded due to advanced technical equipment and know-how. After two weeks we arrived at our goal, while all earlier, fruitless attempts to search for *Kronan* had gone on for more than 30 years. We used modern navigational equipment: proton magnetometer, side scan sonar and in the end low light television. All these instruments together made the finding possible.

On the very first dive at the wreck, we made a video documentation with low light television. When using low light television in clear water as on this particular site, artificial illumination is unnecessary, and one will get very clear and deep pictures, far better than the pictures taken with lamps. This is due to the absence of back scattering, always a problem in connection with artificial illumination under water.

Documentation

The *Kronan* wrecksite immediately created a demand for documentation. The challenge was twofold: documentation for scientific purposes, and for public broadcasting demands. Today, quality and resources common in broadcasting are normally far superior to the requirements for scientific use. Consequently, scientific underwater documentation can gain a lot by professional equipment and knowledge.

We use a military type of low light TV-camera, that will make moonlight scenes look like broad daylight. Under water it will see more than the human eye. Technically expressed, it only needs 10 lux of light. We use a wide angle lense of at least 90 degrees. These types of wide angle lenses have often fixed focus, which means that one does not have to fiddle with distance adjustment.

As porthole for the underwater camera housing, we prefer to use a dome, which can be described as a hemisphere usually made of acrylic plastic. When used correctly a dome does not lose any angular field, in contrast to plane windows. There are many other optical advantages in choosing a dome, too complex to go into here. One must be aware that when putting the dome into the water, from being a spherical window it becomes a negative lens, which means that the camera must allow focus at a very close distance, for example about one foot. This could necessitate wide angle attachment lenses.

Colour Television

In May 1985 we cooperated with Nord-Deutsche Rundfunk located in Hamburg, producing a television program in which we were responsible for the underwater work. At this particular time we used a highly professional TV camera, Ikegami HL 79, and made a very interesting observation. We discovered that one could extend the colour spectrum under water with video technique far more than with film technique.

Water acts as a blue filter, and this will cause certain problems when one uses ordinary film material. The film material available today is, naturally, made for out of water use and is consequently manufactured to have a colour sensibility like the human eye under these conditions. In 1934 William Beebe, U.S.A., was the first to analyse scientifically the absorption of solar light in the ocean waters. The colours are absorbed in the water, starting with the red, then orange, yellow, green and blue, to end in total darkness. At what depths these colours are gradually absorbed depends of course on the type of water. But as a rule of thumb one can say: red 20 ft., orange 40 ft., yellow 70 ft., and what remains is a green-blue mixture ending in blue. This is the visual impression of the human eye and as mentioned before the film material in use today is adapted accordingly.

William Beebe also noticed that instruments could detect green rays down to 1625 feet and blue rays down to 3250 feet, while complete darkness for the eye occurs at 1620 feet. So if we had a material, or an eye, that was more sensitive to selected colours, we would have a completely different impression of colour absorption in the ocean.

The right approach is to use the discovery that light which is white to the eye is a blend of pure colours in spectrum. In practice it means that if one has a certain red, green and blue illumination one can obtain nearly all colours by mixing them in different amounts. This knowledge dates back to Isaac Newton and was later refined by James C. Maxwell, H. Grassman and others. In this way Maxwell made the first colour photograph in history in 1861.

Today we are using this technique in modern and professional colour television cameras. They have one tube for each basic colour, red, green and blue, each tube can be amplified separately and the blend between the tubes can be controlled externally.

By using those type of cameras and gradually going deeper into the water, one can produce a visual impression of red, orange or yellow at depths where the remnants of these colours are invisible to

the human eye. Compared with film material it is like changing the film material for every ten feet one descends.

Another drawback of film emulsion is the delay between exposure and finally developed film, which prevents instant adjustments of the colour recording. In this respect the video technique is far superior. A disadvantage of video is the resolution of the picture, but it will surely be better in the near future.

As a result of the foregoing we use a highly professional broadcasting camera, for example Ikegami HL 79, and a suitable housing with neutral buoyancy, an 8-inch plastic dome, an earbone conductor for directing the cameraman, a hydrophone for recording live sounds and on top of the camera housing we have placed a 2.5-inch monitor to enable the cameraman to see the picture he is shooting.

The camera cable consists of 19 conductors which is a minimum if one wants to have full remote control of the camera, including hydrophone and earphone. With this equipment one will have full colour balance down to more than 100 feet, contrary to earlier known procedures.

Artificial Illumination

When the light is inadequate one must use artificial illumination. Our solution is metal vapour gas lamps, fully colour corrected, so that the light includes all colours. The advantage with these lamps compared with filament lamps is smaller power consumption. One can obtain five times more light out of the same power, something to remember when considering the cables and power supply.

In our team we use three lamps of 400 watts, which each provides the same light as a 2000 watt filament lamp. Each of the three lamps is equipped with an earbone conductor, so that the producer on board the ship will have full control both of the diver who has the camera and of the three divers operating the lamps. The producer also has a video technician on board who controls the video recording, and in this special case the colour mixing.

CCD-Camera

For common use, like every day documentation of the *Kronan* wrecksite, we employ simpler techniques. We use a black and white CCD-camera with a sensitivity of 3 lux, just about the same as the human eye. This type of camera is small, like two packs of cigarettes and very insensitive to shocks or abuse. It is used both as a surveillance camera for safety of the divers and for daily documentation.

The Grid

My latest project, which I believe will be helpful for marine archaeologists, is an electronic device that will record the precise size and extent of objects on the seabed without preparatory work or contact with the objects. Any one who has looked at a television monitor, showing pictures from sea bottom, knows how difficult it is to estimate the size of any object. The reasons are obvious: there are no familiar objects to compare with such as cars, pavements, houses, people etc. In other words objects whose size we know.

To slove this problem I have equipped an underwater camera with a sonar (echo sounder) that measures the distance from the camera to the bottom. The sonar signal then goes up to an electronic instrument on board the ship and injects an artificial grid on the television picture. The size can be chosen by the operator, for example squares of 0.5 meter, 1 meter, 2 meters etc.

The grid then expands or shrinks, in accordance with the signals from the echo sounder, when one lowers or raises the camera from the bottom. If one adjusts the grid correctly so that it gives the right dimension, one can superimpose this grid on the picture of the bottom and then be able to determine the size and location of the object.

The factors that determine the right size are the angular size of the object as seen from the camera lens and the distance of the camera from the bottom.

REFERENCES

The Encyclopaedia Britannica, Eleventh edition. New York.

AHLBERG & GRISELL
1973 *Riksnyckeln 1628*. Forum Navale nr 28, Stockholm

BEEBE, W.
1935 *Half Mile Down*, London

FRANZEN, ANDERS
1981 HMS *Kronan*. Royal Institute of Technology Library. Stockholm.

1941 *Life Magazine* June. New York

1979 *NOAA Diving Manual*, U.S. Department of Commerce, second edition

FRIEZING, HEINRICH, Dr.
1968 *Gesetz der Farbe. Munsterschmidt-verlag*. Gottingen

GOLDMAN, MARTIN
1983 *The Demon in the aether*. Harris, Edinburgh

TELEFUNKEN-FACHBUCK
1966 *Farbfernsehtechnik* 1. Francis-Verlag, Munchen

WESTWOOD J.D.
1981 *J. Phys. E: Sci Instrument. Vol. 14*.

1986 *Philips Lighting Catalogue*, Lighting Division, The Netherlands

BENGT GRISELL
THE ROYAL INSTITUTE OF TECHNOLOGY
DEPT. OF NAVAL ARCHITECTURE
UNDERWATER TECHNOLOGY
S-100 44 STOCKHOLM, SWEDEN

SYMPOSIUM

Fred Hopkins

Economic Effects on Design of Chesapeake Bay Sailing Craft

In September of 1981 at the SUNY Maritime Conference at Fort Schuyler, Prof. G. Gaddis Smith of Yale University delivered the keynote address in which he proposed that all studies in maritime history and ship design should be based on the water-borne movement of people, food, and fuel. It will be the purpose of this paper, therefore, to apply Prof. Smith's theory of maritime history to the oystering vessels of the Chesapeake Bay and its tributaries. Why place the emphasis of this paper on oystering vessels? As pointed out by Frederick Tilp in *This was Potomac River,* the waters bordering Maryland and Virginia are nationally famous for the oyster and it is the single most important product of the Bay.

The story of the evolution of the oystering vessel does not begin with the movement of food, the oyster, but with the movement of people. The topography of Virginia and Maryland forced the early settlers to travel by boat. The shortest distance between two points usually involved crossing water. The rivers and streams were often safer than the primitive roads through the forests. The early settlers found the local Indians using dugout canoes made from one tree and carrying anywhere from one or two to forty paddlers. The Indians hollowed out their canoes by a combination of burning and scratching with stones and shells. Initially the settlers acquired dugouts from the Indians. This type of boat, however, was no stranger to the early English settler. Dugouts were used in Britain as early as 1500 B.C. By the late 17th century, however, the white man had made two major changes in the Indian log canoe. First, using iron tools, he pointed both ends, making passage through the water easier. Secondly, again using iron tools, the white man moved from single log construction to the use of two or more small logs. Perhaps a combination of a lack of large trees and the colonists ability to shape the logs ended the single log type. By using more logs, bigger and bigger canoes could be constructed.

Just as the early settlers needed boats for travel purposes, they also needed these same boats to aid in the gathering of food. The oyster, however, although a prime source of nourishment for the Indians, was not a popular item with the white man. A Virginia settler writing in June of 1623 states that he is starving to death and may even be forced to eat oysters. In 1680 the inhabitants of Kent Island were complaining that food was so scarce that they were reduced to eating the lowly oyster.

By the late 17th century, however, the settlers had begun to appreciate the oyster and by 1737 a professional oyster fishery had come into being on the Bay. The colonial oysterman worked in shoal waters usually from an extended log canoe of three logs and eighteen to twenty-five feet in length. The depth of water from which the oysters could be taken was limited by the workable length of the tongs used to pluck the oysters from the bottom. This length was roughly twenty feet. In order to facilitate his trip to and from the oyster beds, the colonial waterman eventually abandoned the paddles used by the Indians and added a most unique triangular sprit sail. Canoes twenty feet in length and under carried a single sail while those over twenty feet carried two.

During the Revolutionary War, the oyster industry on the Bay came almost to a halt. The industry rebounded after the war and soon the oyster rich Bay was being visited by vessels from New England. The New England oyster beds were exhausted by 1800 and by 1808 vessels from Fair Haven, Connecticut, were in the lower Bay both dredging for oysters themselves and buying from the local watermen. Quickly the Virginia and Maryland watermen realized the advantages of the dredge and tried to adapt it to their canoes. The canoes, however, were too small to drag the dredges and the result was an evolutionary change in the design of the canoe. A larger vessel was needed to haul the dredge, so the Bay watermen just extended their canoes to five or seven logs. The new creation was called a brogan or coasting canoe. In addition to being powerful enough to haul the dredge, the brogan permitted the watermen to harvest beds in deeper water. Travelling to the deep water beds meant overnight trips, so small cuddy cabins were constructed in the forward seciton of the brogan. The ability to make longer trips also permitted the watermen to sell their catch directly to buyers in the markets of Baltimore, Washington, and Alexandria rather than going through the middleman "buy-boat."

Conservation is not a modern idea. The law-makers in both Virginia and Maryland soon realized that the oyster dredge, while a boon to the watermen, would soon deplete the Bay oyster beds in the same manner in which it had ruined the New England beds. In 1811 Virginia passed a no dredging law and Maryland followed in 1820. The demand for oysters continued to grow and soon the shallow water beds were exhausted. By the 1850's enough pressure had been applied to the legislatures of Maryland and Virginia that small dredges were permitted in deep water within the limits of specified counties. The Civil War, like the Revolutionary War, put a temporary halt to the oyster industry. With the conclusion of hostilities, the oyster industry began a thirty year boom. Dredging was now permitted in deep state water with large dredges as long as the dredging was conducted from a sailing vessel. Initially the heavy dredges were dragged behind the existing schooners and pungies. These types of vessels, however, did not adapt well to the oyster industry. The bulwarks of both types were too high and made it difficult to haul the dredge over the side. The plank-on-frame construction of the pungies and schooners proved very expensive and often beyond the financial means of the average waterman. In addition the rough oyster shells rather quickly chewed-up the plank ceilings. Finally, the deep draft of the pungies made them unsuitable for the off-season work engage in by many oystermen of sailing into the small tributaries of the Bay in order to transport farm produce to the cities.

The answer to the less affluent waterman's problem of needing a sailing vessel powerful enough to pull a deep-water dredge, shoal enough for off-season employment, and less expensive than a yard built schooner or pungy was the Chesapeake Bay log bugeye. The Bugeye was another evolution of the log or dugout canoe through the brogan. The watermen simply added several wing logs to the log hull, extended the sides even further by adding ribs and planking above the log hull. The bugeye's canoe ancestry was further shown in its sharp double ended construction. Appearing initially in the early 1870's the Bay built bugeye became one of the largest dugout based vessels developed anywhere in the world.

Through the 1880's the bugeye remained a double ended vessel of log construction, but changes both ashore and on the water were about to alter the design of this vesel. By the 1880's the supply of large logs close to the Bay and its tributaries became scarce. In 1880 half of the 176 bugeye type vessels constructed were of plank on frame construction, greatly adding to the cost. The watermen also realized that both the log and the frame double ended bugeyes presented a problem of lack of working space on the aft portion of the

vessel. In addition, the growth of port facilities on the Bay and rivers forced the watermen to tie-up their bugeyes in close proximity to one another. The pointed stern afforded little or no protection for the rudder. Several solutions surfaced for these problems. In 1881 the first round stern plank on frame bugeye was bult by Robert Lambdin in St. Michaels, Md. This type of stern solved the space problem but again, the yard bult plank on frame hull was expensive. In order to add space to the log built sharp stern bugeye, James Marsh of Solomons, Md., in 1880, developed the duck-tail. Basically two timbers were extended aft of the rudder post as protection and also to provide space for an iron horse to work the main sheet. This arrangement, however, provided no additional work space. In 1908, however, Joseph Robbin of Cambridge, Md., patented a plan for creating a deck between Marsh's two extended timbers. This creation, known as the "patent stern", provided the extra deck space for the sharp stern bugeyes.

In the late nineteenth century two government reports reviewed the history of the Maryland-Virginia oyster industry. Of particular interest is a review of the costs of constructing the various oystering vessels and a summary of operating expenses. For the waterman using tongs to gather oysters and needing a canoe, thirty-five dollars purchased enough logs for a thirty to forty foot vessel. The logs cut and hauled from the forest cost three to five dollars each. A waterman handy with an adz and axe could construct his own canoe for about one hundred dollars. To purchase a finished thirty foot canoe would cost a waterman approximately four to six hundred dollars. The finished canoe would weigh about two thousand pounds and could carry between fifty and sixty bushels of oysters. In comparing a log with a frame bugeye, it is easy to see why the average waterman preferred the log vessel. A log bugeye which could carry two hundred to three hundred bushels of oysters would cost six to eight hundred dollars. A frame bugeye with the same capacity would cost between fifteen and twenty-five hundred dollars. Adding a round stern to a frame bugeye increased the price an addition two hundred dollars. Another consideration in favor of log construction was that a frame bugeye had to be larger than a log bugeye in order to haul the same number of bushels of oysters, since the frame vessel had to carry ballast. The weight of logs in the log bugeye solved the ballast problem. A seventy-five foot log bugeye could hold approximately 1800 bushels and had an average life of thirty-five years. By modern standards the cost of a log or frame bugeye might seem minimal, but not when one realizes that the watermen in the late nineteenth century only earned about forty-seven cents per bushel. In addition to construction or repair costs, the dredge vessel owner averaged about $420 per season in crew salaries and about forty dollars in food expenses for a three week cruise. The dredge vessel would average between twenty to eighty bushels of oysters per day. Of the seven thousand oyster vessels operating on the Bay in 1884, nine hundred were dredgers.

By 1892 a steady decline in the oyster catch along with the scarcity of pitch pine logs and competent adz men brought about another development in the design of Potomac River and Chesapeake Bay oyster vessel. What was needed was a vessel smaller than the bugeye but still able to haul a dredge and employ fewer crewmen. This vessel would also have to be built and maintained without the expensive services of a shipwright and a boat-yard. The dredgers turned for inspiration to a class of small craft used for shallow water crabbing and tonging. The shortage of pine logs in the late 1800's had forced these watermen to develop a frame-less V-bottomed skiff based on the design of a New Haven sharpie that had drifted loose from a New England schooner in the Bay. These crabbing and tonging skiffs had few curves so they did not require the services of a boat-yard and a shipwright. The bottoms were V-shaped and cross-planked. By expanding these construction principles to a larger vessel, the watermen were able to produce a design that anyone with a fair amount of skill with tools could build and maintain. The vessel type has become famous as the skipjack. Although the first recorded skipjack was built in 1888, Chapelle points out that little appears in print about them until 1910. The ban on oyster dredging in the Potomac in 1931 caused many shipjacks to be hauled ashore and left to rot. Colonial Beach became a popular graveyard.

All of the vessels discussed thus far were found all over the Chesapeake area and were not in anyway specially linked with a particular tributary. Two vessel types, however, a doryboat and a longboat, were peculiar to the Potomac River. In his 1834 treatise on shipbuilding, Henry Hall mentions the Potomac Longboat, an undecked centerboard schooner, which was mainly employed carrying fire-wood up river to Alexandra, Georgetown, and Washington. These boats had a very shallow draft and were of very flimsy construction, suited only for sheltered waters. Appearing first in about 1815, the Potomac Longboat lasted on the river until 1933 hauling wood upstream and general produce on the downstream run. Their light construction and the shift from wood to other sources of heat and power marked the end of this unique craft.

The final craft to be discussed is the Potomac River Doryboat of the late nineteenth century. Frederick Tilp, once a captain of a doryboat, describes this craft as developing from the flat-bottomed, eighteen to twenty-seven foot black-painted sailing vessel called the Black Nancy used for smuggling on the Potomac during the Civil War. At the conclusion of hostilities, these vessels were converted to oystering and crabbing. The popularity of the oyster in the closing years of the nineteenth century brought a demand for a lager vessel and the Potomac River Doryboat was the result. No relation at all to the flat-bottom doryboats of Maine and New England, the Potomac version was planked for and aft with a moderate "V" bottom and a complete set of frames. The up-sweep at the bow necessitated the steaming of the strakes. Averaging between twenty and thirty feet in length, the doryboat was a yard-built vessel. Originally designed to carry a ketch rig, many doryboats were later converted to carry gasoline engines. Two examples of doryboats still exist. At the Calvert Marine Museum at Soloman's, Md., the *Let's See*, a gasoline engine powered version, is on display in the Small Craft Shed. One of the last doryboats constructed in 1917, the thirty foot *Shamrock*, has been restored as a sailing craft and is currently owned by the Lundberg Maritime School at St. Michaels, Md.

In conclusion it is interesting to note that of the eight types of vessels discussed in this paper, all but the dugout and the log canoe were craft conceived and developed within the confines of the Bay and its tributaries by local watermen and shipwrights attempting to cope with the demands placed upon them by a changing society and environment.

FRED HOPKINS
UNIVERSITY OF BALTIMORE
BALTIMORE, MD 21201

SHELI SMITH
DAVID SWITZER

Hart's Cove 1986 Field Report

In 1980 through a remote sensing survey of New Hampshire's Piscataqua basin, archaeologists discovered the remains of a small wooden vessel. Closer inspection revealed an artifact assemblage dating to the 1690s. The Institute of New Hampshire Studies (INHS) returned to the site in 1981 and 1982 to assess the amount of hull preservation and recover a better sample of representative artifacts. Through inquiry among sport divers, the INHS team led by Dr. David Switzer of Plymouth State College found that a decade ago local sport divers also discovered the site and removed as many intact artifacts as they could find. The whereabouts and condition of those artifacts is now lost. However, the hull was left untouched by the sport divers and covered by their spoil piles, sealing the site from damaging exposure until the 1980 discovery (Switzer, 1980:5-7).

The INHS team successfully mapped the exposed portions of the hull and collected a solid representative sample of datable ceramics. The conclusions of the early eighties field work recognized the rare value of the Hart's Cove wreck. In 1986, the Maritime Archaeological and Historical Research Institute (MAHRI) set about a thorough investigation of the site, led by Dr. Switzer. Funded by the Greater Portsmouth Charitable Foundation and in-kind donations from Klein Associates, the MAHRI team proceeded to completely open and record the aft 25 ft. of the hull (Switzer, 1986). The following is a description of the 1986 findings.

The keel is extant back to the stem post scarph. However, intermittent exposure over the last seven years has greatly accelerated the wood deterioration. All evidence of deadwood and stem structure is gone. Actual hull remains begin approximately 10 ft. forward of the keel end (Figure. 1). Over the next 15 ft. the hull is intact up to the turn of the bilge on its starboard side.

One inch thick pine firring sheathed the oak hull which rested on a mud and gravel bottom. Between firring and planking the hull was painted with a pitch and horse hair concoction. Varying widths of 2 in. oak planks formed the hull. The four consecutive strakes after the garboard strake suggest a tightening of the aft part of the hull (Figure 1).

Hart's Cove vessel was framed in alternating floor/futtocks and "sistered" half-frames. Sided and moulded dimensions of the frames recorded at centerline range from 3 in. to 5 in. by 4.5 in. The fastening pattern suggests that the floors were laid first at intervals of 21 in. to 23 in. on centers and then clamped in place by a short keelson or fastened to the keel. At least three hull planks were then trunneled in place. Next, opposing half-frames which just crossed the keel line were laid in place between the floors. The floors and frames were then clamped in position by two, 18 in. wide, pine ceiling planks. The ceiling, half-frames and outer planking were fastened together by trunnels. After the half-frames were in place then the first futtocks which toed into the floors were laid. Using "leap-frog" construction the entire hull appears to have been built up in alternating stages.

The short keelson which rode on top of the frames carried a mortise thought to be a mast step. Both spikes and trunnels fastened the keelson to the frames. Next to the keelson and above the frames were three extant ceiling planks. The first two planks were 18 in. wide and preserved at 14 ft. 9 in. Regular trunnel patterns marked the location of each half-frame and random, small, square nail holes showed where the planks had been tacked down originally. In addition to the fastening pattern, two sets of sawyer marks were recorded.

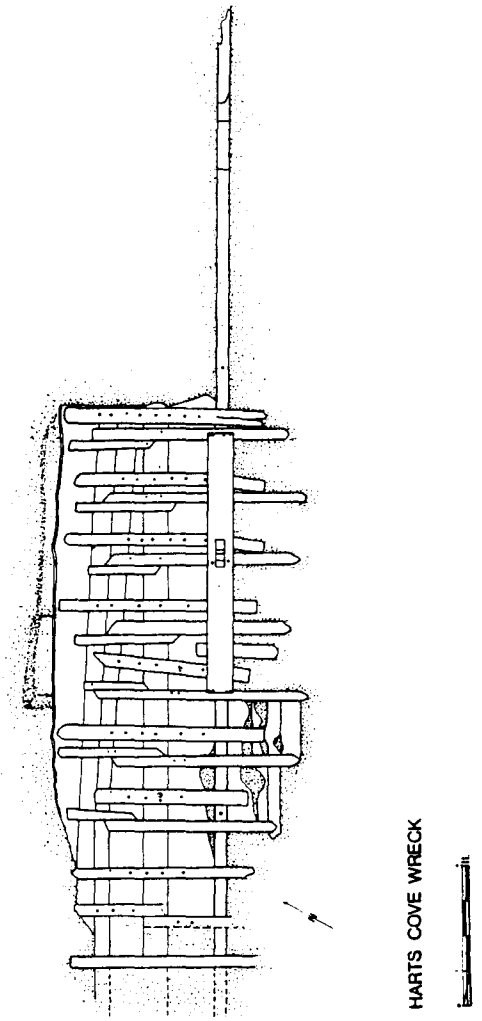


FIGURE 1. 1986 Hart's Cove Wreck preliminary plan

At the end of the six week season systematic probing of the site revealed more structure still buried. The probing results raise the possibility that some fragment of the hull's entire run may still exist. In addition to the hull documentation, further sampling of the spoil artifacts produced 194 cataloged finds which are now undergoing conservation treatment. Among the various compositions, the Hart's Cove team recovered a good selection of ceramics believed to have been part of the ships cargo at the time of sinking.

The major category of ceramics came from the Biddeford/Barnstaple potters of North Devon, England (Grant, 1983:123). Gravel tempered utility wares such as a pitcher and a small pot were found among this type. Also abundant among the spoil pile were sherds of sgraffito ware. Several large fragments display simple scratched bird designs. In addition to the North Devon wares were fragments of a Westerwald mug originally discovered in 1982. The mug is decorated with the crest of Wilhelmus Rex. Included in the ceramics were 95 clay tobacco pipe stems and 26 bowls. The stem bore diameters range in size from 4/64 to 8/64 with the greatest number measuring

6/64. Applying the Binford regression formula to the stem bore diameters produced a date of 1692 (Binford, 1976:66-67).

Possibly another part of the cargo was wine. Over the years numerous fragments of green, onion shaped, wine bottles have been recovered. This form was popular in the late seventeenth century and further supports the 1690s date of sinking (Noel Hume, 1976:63).

The Hart's Cove wreck attests to Portsmouth, New Hampshire's thriving economy in the late 1600s. Sketches of the port depict several bustling piers. Port and merchant records record the importation of finished goods and the dispersal of those goods up and down the seaboard. However, until now little was known about the small costing vessels that crowded the sheltered coves, like Hart's Cove, near the mouth of Portsmouth's deep water port. These work horses of the colonial period transported the pottery, pipes and wines of England along the last leg of the journey. Historical research is now underway in an effort to identify the wreck in Hart's Cove and better understand the role of the coasting vessel in the Portsmouth economy.

REFERENCES

BINFORD, LEWIS

1978 A New Method of Calculating Dates from Kaolin Pipe Stem Samples. *Historical Archaeology: A Guide to Substantive and Theoretical Contributions*, pp. 66-67. Baywood Publishing, Farmingdale, New York.

GRANT, ALISON

1983 *North Devon Pottery: The Seventeenth Century.* University of Exeter.

NOEL HUME, IVOR

1976 *A Guide to the Artifacts of Colonial America.* Alfred A. Knopf, New York.

SWITZER, DAVID

1980 Piscataqua Basin Survey Phase 1, 1980. *Institute of Nautical Archaeology Newsletter, vol. 7 no. 4: 5-7.*

1986 *Hart's Cove Wreck Site Archaeological Investigation; 1986 Field Report.* Maritime Archaeological and Historical Research Institute.

SHELI SMITH
DAVID SWITZER
c/o MAHRI
BRISTOL ME 04539

DANIEL LA ROCHE

The Small Boat Finds at the "Musee de la civilisation" in Quebec City

During monitoring of the construction of a new museum in Quebec city in 1984 and 1985, the remains of eight small boats all dating from the eighteenth century were uncovered. Nevertheless, only six of them were salvaged. Following a brief introduction, I will present these finds in the order that they were uncovered.

The government agency that chose the location of the museum in a historical part of the city was not particularly interested in a conservation policy and lobbying from archaeologists did not succeed in convincing the authorities to change the location, to modify the project, or, at least, to postpone the construction until further archaeological investigation could be done.

The Flat Bottom Boats

While pressure was being put on government, and before the arrival of excavation machinery, I was given final permission to excavate the remains of a boat discovered by a team of archaeologists in 1975 and which was from that time still lying under modern fill on the former beach at the same location as the museum (Figure 1, B1). I had been waiting for this moment for a year and a half, at which time I first presented a project to recover the hull.

For the salvage operation I adapted methods of labelling and recording used by the underwater archaeology project of Parks Canada in Red Bay, Labrador. The main goal was first to recover the half of the boat already known and, afterwards, to locate the other part still hidden by earth fill.

I think the poor condition of the wood belonging to the freshly uncovered part resulted from the absence of water in fills above the tide level. I finally managed to record and retrieve the remains of the boat for future reconstruction. Pieces from this original flat bottom boat were drawn independently and a scale model should be undertaken soon. Following the field investigation, a description of the remains and a chronological discussion was presented in the site report. The main conclusions of the analysis were that the boat, abandoned shortly before 1751, was a small flat bottom construction with a 10.25 meter overall length and a 1.35 meter width at the sole. Often called "bateau plat" in documentation, it was pinched at both ends. We counted twenty equidistant frames that were nailed to the bottom planking. Soft and hard woods were used in the construction and symmetrically positioned to give the maximum of strength to the structure. Wood identification still remains to be done. Many other details were noted like the presence of inside planking on the sole and the identification of an iron eye still driven in the stem. There would be much to say on the subject but we now want to present subsequent discoveries that are intimately related with this first find and which give us more clues to understand small boat production in the Quebec area.

While finishing the recovery of the boat, I was asked to monitor the overall excavation for the new museum. As I was very much interested in maritime archaeology and as nothing had been done before in that field in Quebec city, I accepted the proposition.

To help the reader to understand both the complexity of the project and the context of the discoveries, it is necessary to mention

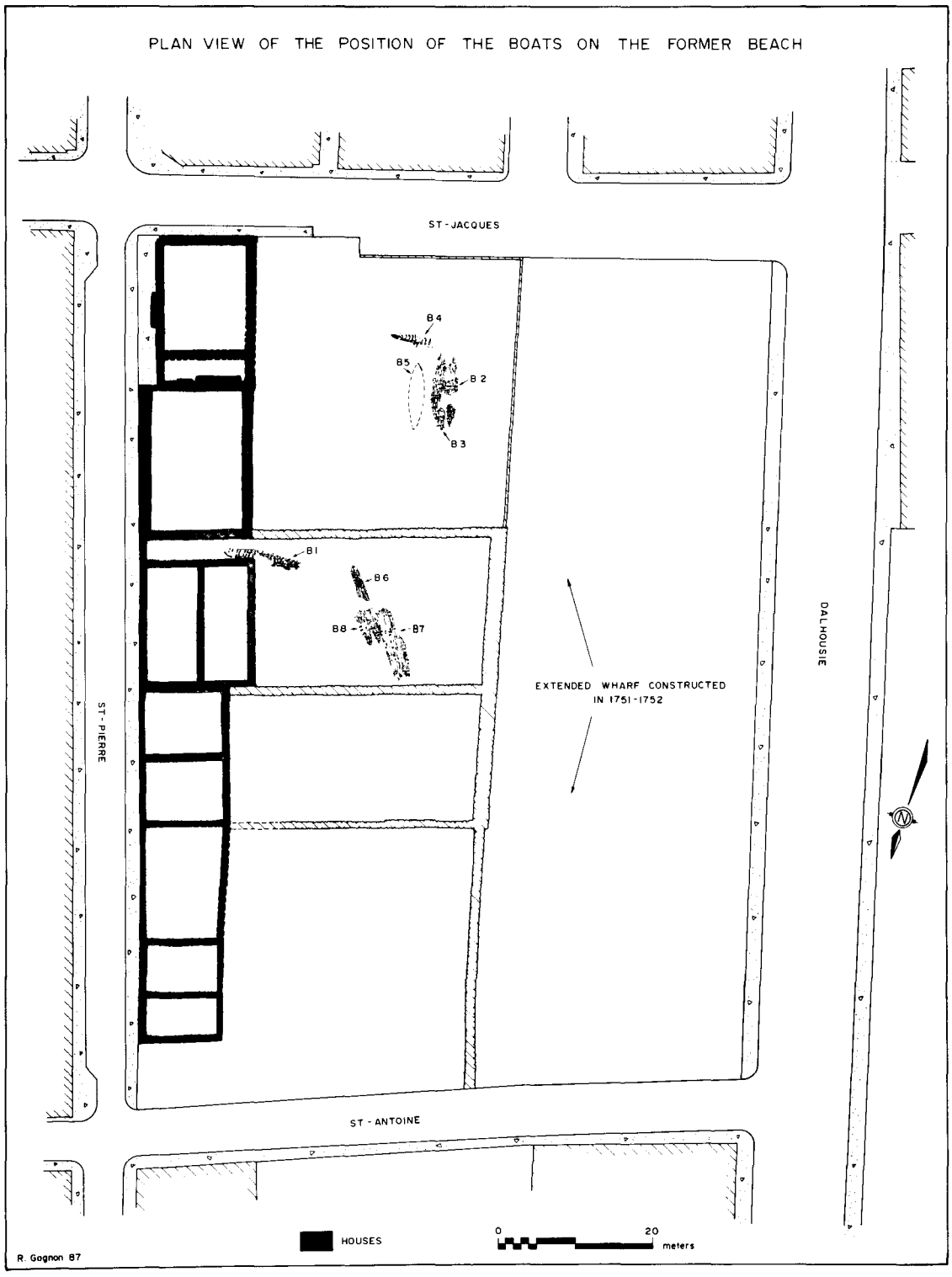


FIGURE 1. Plan view of the position of the boats on the former beach

that there were different stages in the development of this area of the waterfront, between 1701 and 1875. I was determined to focus a part of the analysis on the evolution of the harbor installations being uncovered when new finds thought to be pieces of a boat were discovered in one part of the site adding more pressure to our work. The pieces seemed to be a part of a small boat very much like the one we had excavated a few months earlier. After different legal and financial steps, I was finally allowed to excavate during the month of February, under a temporary heated shelter while outside temperatures were ranging under minus 15 Celsius. In any event, our team was lucky to find not one but two small flat bottom boats, lying side by side (Figure 1, B2, B3).

To add to the surprise, while proceeding in the excavation of the boats, we realized that scattered pieces from a different boat in a very bad state of preservation were crossing their hulls almost perpendicularly (Figure 1, B4). Finally, futtock heads of a fourth boat were protruding from the side of the trench (Figure 1, B5). After consultation with the authorities, it was decided to concentrate our attention on the recording and preservation of the first two boats and later try to record supplementary data during the extensive excavation operation. Fortunately, we succeeded in salvaging a well preserved portion of a flat bottom boat which appears to be one of the latter specimens (Figure 1, B4, Figure 2)

Interpretation was facilitated by the fact that these finds were not isolated discoveries. The examination of similarities in terms of materials, shape, size of pieces and joining was to give us a better idea of construction techniques. The first goal was to find out at what time they were abandoned on the beach. This was relatively easy as an extended wharf was constructed in 1751-1752, and the assemblage of boats behind it seems to have been used as a temporary dam during the construction of the wharf. The hulls were subsequently covered by tons of rock and fill material which sealed them until 1985.

We may now take a closer look at comparable elements from these boats and particularly the "twins" (B2, B3). Even though they were in a bad state of preservation, we were able to draw plans and cross sections of the remains of both boats. The first observation made was that they look almost the same as the boat previously recorded. Pinched at both ends, one boat is longer and larger than the other: 10.54 meters of total length and 1.30 meter for the width of the bottom or sole (Figure 3). In comparison the second was respectively 9.92 meters and 1.23 meter (Figure 4). The dimensions of planks and frames, variable from one specimen to the other, are also variable within each boat. Planking of the specimens in carvel fashion was also observed and preliminary identification of wood species from only one specimen has been made. The samples analyzed revealed a surprising pattern in which the builder did not respect symmetry in the disposition of wood species, for instance white pine and white oak which were used indiscriminately.

The angle given to the naturally curved knees made of soft wood was constant on each boat and similar from one to the other. Nails were used to fasten timber parts on both examples.

Still many details could be noted about these hulls. Examination of the remaining pieces from these boats and from the others should be undertaken in order to complete the analysis of these archaeological artifacts within a comparative perspective. Studies of this kind of boat are underway elsewhere in North America and we hope to be able to obtain further funds to complete our own research in the near future. The examination of technological details may tell us if these models were inspired from ones used in France, the country of origin of most of boat builder's families in Quebec City at that time. The adaptation of European technology to North American reality remains to be documented. Colonization of new lands required transportation of troops and settlers and as rivers were sometimes hazardous for large vessel navigation, these cheap and sturdy boats would have provided a means to achieve that goal.

The Sailing Boats

Three more wrecks of a different type were discovered during the same winter as the excavation for the Museum progressed (Figure 1, B6, B7, B8). They were lying in the same area as the boat already found in 1975. The first pieces exhumed convinced me that we had encountered different models. Unfortunately, machinery damaged the bow of the largest one and a very large portion of the third disappeared while machinery kept working around to clear the place. It was nonetheless possible to record and to recover two of them. I submitted a project and finally convinced the authorities of the importance of the find. I was mandated to do preliminary recording and to undertake the recovery of the remains. In order to accelerate the work, and also because it was impossible to change the construction schedule, I hired a firm who took stereometric views of the boats before the archaeological team started the construction of frames designed to lift them up as found. The first boat was tilted on her starboard side, parallel to the shore line (Figure 5). Her central part had disappeared in 1853 with the construction of the foundations of a large warehouse. The forward section was in a bad state of preservation when compared to the stern section.

The boat was moved in two parts to an outside location while waiting for a laboratory space. A humidifying system was installed for the timbers and dismantling her started one month later. The main reason was that the structure was suffering from excessive weight, caused by the earth and ballast sandwiched between planking but also, from temperature variability. The measurements taken on each individual piece allowed us to tentatively reconstruct this model. With a length of 10.86 meters, she bears a total of 25 frames. The boat presents a sharp bow and a rounded stern. Sections of deck forward and aft were recorded, leaving the central part for cargo. In this latter part, a ceiling covers the frames and permitted easier stacking of merchandise and protection from water. A mast step in the forward section indicates that the boat could navigate with at least one sail. No traces of a rudder were visible. They probably used a steering oar to direct the boat. A conservation program was instituted to preserve the remaining parts of this boat. Although we lost parts of the outside planking, the frames are in relatively good state of preservation and we can anticipate reconstruction.

The second wreck lying beside the first was dislocated (Figure 6). Her bow was missing, partly destroyed by the wall erected in 1853 and by modern machinery. The interior of the hull was covered with ceiling planks but no evidence of partitions or of seats appeared on the remaining structure. The strapped hull was moved in one block to the same location as the first, and it was kept outside for about a month before being moved to a warehouse where a special laboratory unit was organized. Once there, it was supported and the envelope was cleared. A detailed plan was then drawn and the reconstruction process started, both on paper and on the original pieces before drying of timber started. I proposed a model of a total length of 12.76 meters with an estimated number of 26 frames. A mast step mortice carved in the keelson was noted almost in the center of the reconstructed model.

This detail indicates that at least one sail was in use on this specimen. A large deadwood piece helped us to find out the best shape for the forward section. Although we don't have time to detail technical features of this second example, we would like to note that both specimens of sailing boats examined seem to represent a unique naval tradition in terms of shape and construction techniques.

FIGURE 2. Overall view of the remains of a flat bottom boat (B4)

FIGURE 3. View of the best preserved portion of a flat bottom boat (B2)

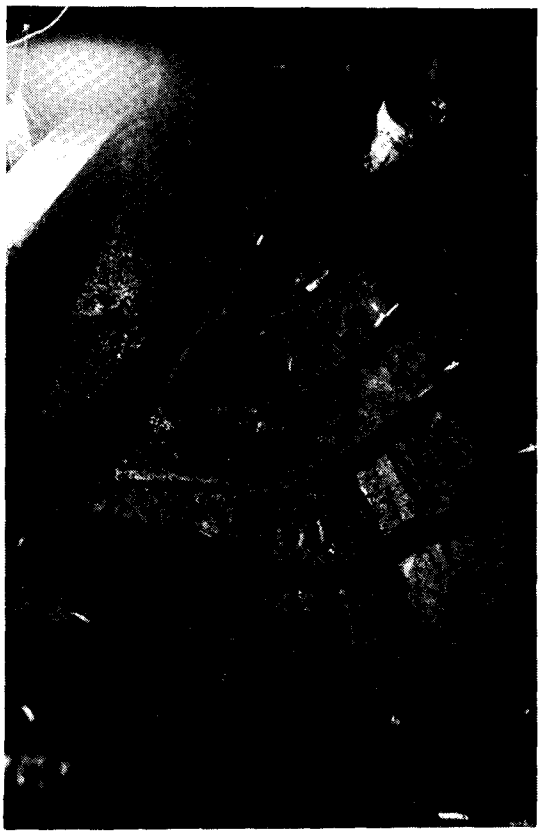


FIGURE 4. View of the best preserved portion of a flat bottom boat (B3)

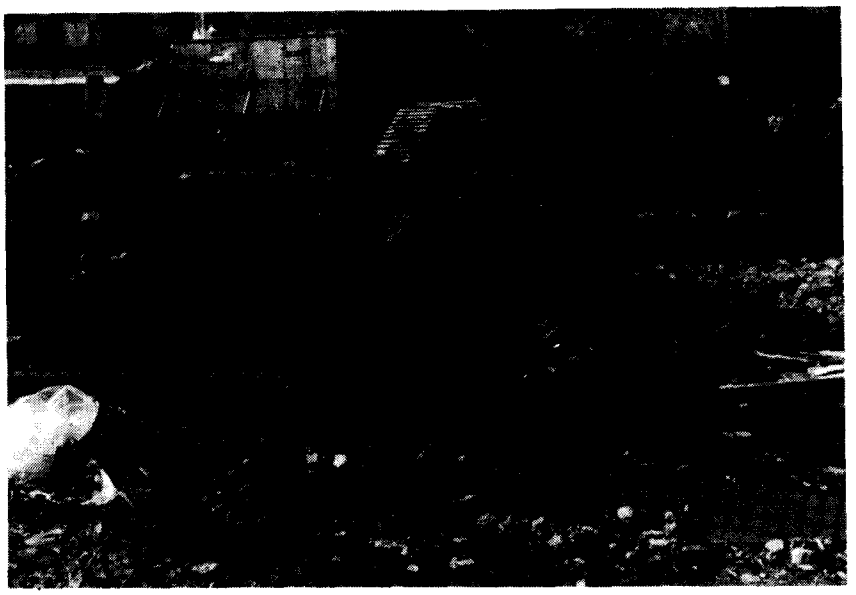


FIGURE 5. General view of one of the sailing boats (B6)

FIGURE 6. General view of a second sailing boat (B7)

Comparative drawings of main structural pieces tend to confirm this appraisal. The examples we can cite refer to similarities observed in design of scarf joints and deadwood pieces from both sailing boats. Although mid cross-sections drawn after archaeological data (drawings) look different on comparative pictures, we think that some corrections may be necessary if we experiment with small scale reconstructions. Furthermore, we noted that iron nails were extensively used to fix frames and planking of carvel fashion. Wood species identification revealed surprising details such as the intensive use of birch in structural pieces along with cedar and larch. White oak was definitely absent on the smaller boat but covered the outside planking of the largest.

The third wreck encountered, although badly damaged, is clearly of the same type with similar frame spacing and dimensions (Figure 1, B8). This last example offers an additional argument to conclude that the wrecks are related to the same event and that a better study of their hulls is important for the understanding of boat construction in Quebec city.

As these hulls are well dated, the data that their analysis offers is all the more important. An example of what it implies on related data can be illustrated with assemblage techniques and wood species used in the construction of some of the boats. They revealed nondurable design features that would effectively limit the lifespan of such boats which we evaluate at a maximum of 8 to 10 years after construction. Dendrochronological analysis confirmed this evaluation. Further comparison of construction details will give us a better understanding of process transformation and adaptation occurring in construction techniques during French colonial regime for the small boats of the area.

In conclusion, there would be very much to tell and to learn from those artifacts and we hope to complete research from both a technological and an ethnohistorical perspective.

REFERENCES:

LA ROCHE, DANIEL
1985 *Rapport d'étude préliminaire suite a la fouille de l'embarcation située dans la cour de la maison Estèbe, à Québec.* Rapport non publié déposé au Ministère des Affaires culturelles du Québec.

LA ROCHE, DANIEL
1986 *La surveillance et le sauvetage de vestiges archéologiques au Musée de la civilisation a Québec*, Rapport non publié déposé au Ministere des Affaires culturelles du Québec.

DANIEL LA ROCHE
49 RUE VERRET LORETTEVILLE
P.Q. CANADA G2B 1G7

SYMPOSIUM

DONALD G. SHOMETTE

The Pitcher Wreck: An Exercise in Crisis

On the evening of Friday, February 25, 1870, the 494-ton round-stemed, wooden steam freighter *New Jersey* departed Baltimore Harbor, Maryland, bound down Chesapeake Bay for Norfolk, Virginia. It was expected to be a routine voyage of 17 to 20 hours' duration. Her lading totalled 750 tons of freight, which included 1,500 bushels of corn, barrels of pork, beef, bacon, flour, and petroleum, and 60 tons of guano. Also included was an enormous variety of miscellaneous merchandise ranging from crates of fruit preserves in bottle, pharmaceuticals, perfumes in decanters, and china to lamps, wagon wheels, music boxes, birdshot, and naval supplies. The cargo was valued at no less than $40,000.

Built at Baltimore in 1862 by Fardy Brothers and outfitted with engines by Reamy and Archibald of Chester, Pennsylvania, *New Jersey* was specifically designed as a canaller for the Commercial Transportation Company of Trenton, New Jersey. Her dimensions of 166 feet 9 inches in length, 22 feet 10 inches beam, and 9-foot depth in hold permitted her to easily traverse the distances from the Delaware River to Chesapeake Bay via the Chesapeake and Delaware Canal, and from the Delaware River to New York City via the Delaware and Raritan Canal. Built as a steam propeller, she was also for and aft schooner rigged, with three masts to provide auxiliary or emergency power.

Her commercial life was interrupted by the Civil War, and in 1864-65 she was employed as a U.S. Army transport, hauling not only supplies from New York to the James River, but Confederate prisoners from Virginia to the Union P.O.W. camp at Point Lookout, Maryland, and Federal troops to various points in the Chesapeake. At the close of the war she was returned to commercial service on the Delaware River and in Chesapeake Bay. In 1867 *New Jersey* was acquired by the second oldest steamer line in the Maryland-Virginia Tidewater, the Baltimore Steam Packet Company (also known as the Old Bay Line), in trade for the sidewheeler *Thomas A. Morgan* and $2,000. She was thereafter employed irregularly, running extra freight between Baltimore and Norfolk.

At about midnight on the evening of February 25, as she approached a large, sandy islet known as Sharp's Island, off the mouth of Choptank River and approximately 40 miles south of Baltimore, fire was discovered admidships and between decks. Her commander, Captain A. K. Cralle, and his ten crewmen were unable to staunch the flames and were forced to abandon ship. Despite Cralle's efforts to haul the flaming ship onto Sharp's Island Shoals so that salvage of the below-decks cargo might eventually be carried out in shoal water after she sank, the overladen vessel went down in eleven fathoms. The ship's owners met two days later to determine whether or not a salvage effort should be launched and decided in the negative. The company's first major total loss in 27 years of operation—the first steam propeller to regularly operate on Chesapeake Bay, and one of the last all-wooden sail-steamers-would be forgotten for the next 105 years.

In the Fall of 1975, Nautical Archaeological Associates (NAA), of Upper Marlboro, Maryland, was asked by a bay waterman to examine a large obstruction recently discovered off Sharp's Island, but not noted on any nautical charts. Guided to the site by Captain Varice Henry, who discovered it with his fish finder, NAA found it to be a wooden shipwreck and conducted a preliminary five-day hands-on reconnaissance. The wreck lay in 45 to 70 feet of water. With the exception of a natural scour pit amidships which had exposed portions of the hull and cargo area, the upper portion of the boiler/engine complex, and sections of two large anchors, the site was found to be largely buried beneath the sediments and in a good state of preservation. Crates and barrels of cargo were still in place, covered by sediments ranging from inches to several feet in depth. Limited sampling of diagnostic materials was carried out, and the site's identity readily determined to be that of the steam propeller *New Jersey*. Field notes and records of the reconnaissance were submitted to the Division of Archaeology, Maryland Geological Survey. The diagnostic artifacts recovered during the sampling operation, after study and stabilization, were placed in the collections of the Calvert Marine Museum of Solomons, Maryland, the Chrysler Museum of Norfolk, Virginia, and the Ogilvy Museum of Wheeling, West Virginia.

Owing to the then-uncertain authority of the State of Maryland over submerged cultural resources in Maryland waters, State Archaeologist Tyler Bastian sought legal counsel from the Department of Natural Resources concerning jurisdiction over the site. It was determined that, according to the Archaeological Resources Act of 1968, all archaeological resources lying on and beneath the bottoms of navigable waterways in the state belonged to the state and were to be administered by the Office of the State Archaeologist at the Maryland Geological Survey. However, with no program in existence for the management of such resources, no staff with sufficient expertise to evaluate such sites, nor even the capability to monitor such large sites as the *New Jersey* wreck (in which between 2.5 and 6 million artifacts were estimated to survive), it was decided that the find be kept confidential until some format for its ultimate disposition could be developed.

In 1978, the National Oceanic and Atmospheric Administration (NOAA) began conducting wire drag operations in the upper Chesapeake Bay. In the course of these operations, the wreck of the *New Jersey*, then unknown to NOAA, was encountered, and the ship's still-standing smokestack was toppled as an obstruction. NOAA divers were sent to investigate the site. Its identity was correctly assumed to be that of the *New Jersey*. The site's LORAN C position, longitude and latitude, and description were entered into NOAA's Automated Wreck and Obstruction Information System as number 02778 and published in the following year on NOAA charts 12263, 12266, and 12267. Both the AWOIS records and new editions of NOAA nautical charts were then and are still constantly perused by dive shops and dive charter operations in the Bay area in hopes of finding new wrecksites. Within a year of the publication of *New Jersey's* position, the site became a mecca for regional sport diving activity and surface relic hunting.

Learning of the inordinate activity on the site in 1982 but concerned over the superceding of antiquities codes by admiralty law in other states and the consequent destructive confrontations wrought by such precedent-setting cases, Bastian sought the counsel of the Maryland Attorney General's Office. Again, the state's managerial rights over underwater archaeological sites was confirmed.

Simultaneously, Bastian embarked upon a program of management by compromise and communication. With my assistance and with that of Dr. Fred Hopkins of the University of Baltimore, and several state museums and educational and archaeological institutions, the Division of Archaeology sought to open channels of communications with the sport diving community. The upshot of this effort was the formation of the Underwater Archaeological Society of Maryland in 1984.

As a consequence of Bastian's efforts to secure the input of the

diving community in the evaluation of the submerged cultural resource base of the State of Maryland, data pertaining to shipwreck sites began to trickle into the Maryland Geological Survey. In October 1983, one of these sites was investigated by me and MGS archaeologist Joseph McNamara. The wrecksite, a 103-foot-long wooden sailing vessel in the Severn River, west of Annapolis, was believed to date from the middle to late 19th century and, owing to its almost complete burial, was in a substantial state of preservation. Word of the MGS investigation of the site was soon circulated and spurred an increase in large-scale relic hunting at the site. Within several weeks, airlifting was being carried out. Alerted to the dredging operations which were themselves violations of the Maryland Water Resources Act, the Maryland Department of Natural Resources Marine Police descended upon the salvors to investigate. The confrontation ended in a standoff. Though one salvor was in the water and his dredge was ready to be deployed when the police arrived, no artifacts had been taken onboard his boat. DNR counsel later stated that the salvor had to be apprehended while physically removing artifacts from the site and actually altering the seabed itself. Later inspection of the site revealed that approximately 475 square feet of the ship's stern had in fact been cleared down to the hull, and fragile sections of the exposed hull stove in. Ironically, the salvor was not arrested by DNR, but was later arrested by the U.S. Coast Guard for pirating the bronze propeller from the modern bulk freighter *Marine Electric* a day after she tragically went down off Assateague Island, Maryland. The affair only served to dampen trust in the state's ability to monitor or manage underwater sites without appropriate in-house expertise.

Despite the developing rapport with the diving community and the successful promulgation of two underwater archaeological field schools, at Point Lookout State Park and in the Patuxent River at Savage, Maryland, sport diver attentions on the *New Jersey* continued unabated. By the Summer of 1985 it was learned that relic hunting had gone far beyond surface collecting. The site had become the target of weekly forays by dive shops and diving charter operations from Washington, Baltimore, Annapolis, and the Eastern Shore of Maryland. Heavy dredging operations were being reported, as were schemes to raise the ship's anchors, stack, and propeller. As a consequence of these activities, Bastian convened a meeting of all concerned parties on September 10 in Annapolis. Attendees included charterboat operators, sport divers, professional salvors, dive shop owners, and representatives from the state's archaeological and educational institutions.

It became readily apparent that site activity was far more intense than had been supposed. One charter boat operator had spent over 900 hours on the wreck and had brought in cartons of intact glassware to illustrate his success. Bastian, in a spirit of compromise, requested voluntary diver compliance with Maryland's antiquities codes and the Water Resources Act, emphasizing that he could, if necessary, order the site patrolled. From discussion at this conference, it became clear that intense dredging in certain sectors had vacuumed the site of substantial overburden, exposing the hull and all that lay within it to the destructive marine biota of the Chesapeake.

On September 30, NAA sought state and federal assistance to conduct a limited archaeological reconnaissance of the site. Through the good offices of Edward Miller of NOAA's Monitor National Marine Sanctuary program, the Maryland Geological Survey, and the Maryland Historical trust, a side-scan sonar survey of the site was scheduled for November, and emergency funds for a follow-up hands-on site evaluation immediately afterwards were made available.

NOAA agreed to provide EG&G side-scan sonar units, through the assistance of the firm of Eastport International, as well as the track-plotter system, and technicians. A Min-Ranger II data positioning system was employed with fixed-point transponder stations erected at the Naval Research Laboratory at Annapolis and at Cook's Point at the mouth of the Choptank River. The 165-foot Environmental Protection Agency Ocean Survey Vessel Peter W. Anderson was to serve as the survey platform. The survey was to be a dry-run operation for the larger *Monitor* site survey scheduled for several days later.

NOAA had already conducted preliminary tests of the equipment off Annapolis on the site of a four-masted schooner wreck, the *Herbert W. Maxwell,* which had been sunk in 1911 by a collision in 80 feet of water. The side-scan results were superb. We had hopes that equally positive results would stem from the *New Jersey* survey.

On November 14, seven runs were made over the *New Jersey* site, and three excellent images were produced for diagnostic evaluation. These were utilized on the following several days during the hands-on investigation. It readily became clear that the entirety of the site was now well exposed, although a few sections of the hull appeared to have collapsed inward. The hull itself was clearly defined, as were such features as the anchors, the boiler/engine complex, a large flywheel amidships, a forward bulkhead, and large scourpits within the hull itself.

On November 15 and 16 an intensive hands-on evaluation of the wreck was carried out under less than optimum conditions, with visibility averaging approximately 12 to 18 inches. While engaged in the investigation, relic hunters arrived on the scene and commenced diving on the site. Despite the presence of archaeologists from both the Maryland Geological Survey and the Maryland Historical Trust, no effort was instituted by either agency to prohibit the relic hunting that was observed to be underway.

Upon completion of the investigation, it was concluded that the stern of the vessel was entirely cleared of all sediments. The propeller, which was still buried in 1975, was now almost completely exposed. Measurements of exposed stern frames, planks, ceiling timbers, and the propeller were made. The starboard hull was substantially intact, and the remnants of a major bulkhead, possibly featuring an intact passageway, were noted. The disarticulated remains of the burned and collapsed pilot house and cabins were encountered in the forward section of the site, now largely exposed. The anchor complex, once partially buried, is now completely cleared, as are a complex of anchor chain and large pieces of concreted iron. A scour area along the exterior port hull reveals the hull below the turn of the bilge. Admidships, a large six-spoked iron flywheel of undetermined use is completely exposed. The boiler and engines, condensers, reduction pipes, A-frame, crosslegs, piston, etc., are all entirely free of sediment cover. The smokestack, however, known to have been on the site in 1984, was not encountered and may, like many other removable sections of the machinery, have been plundered. Immediately forward of the boiler/engine complex a large pit six to eight feet in depth revealed hundreds, perhaps thousands, of shards of broken glass in a section where intact crates of milk-glass molasses pitchers had been encountered in 1975. There is severe pitting throughout the site, suggesting intensive digging, and may fragile features, such as shelving, and small closet areas, once covered, are now revealed. It is now believed that dredging activities may have actually caused an alteration of the hydraulic flow over the site, inducing a natural scouring action throughout the length of the hull.

Thus exposed to the environment and the destructive biota therein, the *New Jersey* will not long endure. Since the 1985 survey, various schemes have been discussed for the management of the *New Jersey* site. No institution was prepared to conduct an intensive survey of the site owing to its enormous size, depth, and low-visibility environ-

ment. The lack of a regional conservation facility suitable for stabilizing the enormous amount of waterlogged cultural materials that might be recovered was another factor which discouraged further evaluation of the site. And of course there was always the cost factor. In August 1986 NAA offered a proposal and plan to physically rebury the site to temporarily stabilize it and prevent further natural and man-made site destruction, but the cost was considered prohibitive.

In August of this same year, I experienced the good fortune to participate in a joint National Geographic Society-National Park Service expedition to Isle Royale National Park in Lake Superior. The project was designed to photographically evaluate several deep-water wrecksites in Park waters using National Geographic's remotely operated vehicle *Searover* and a second ROV, *Minirover*. Capable of producing excellent video and photographic records, the ROVS, in a ten-day operation, proved invaluable in recording site data that would have taken a year or more to obtain in a traditional manner. The project was a stunning success and demonstrated the unique value of ROV technology in archaeological survey work. However, for National Geographic and NGS project director Emory Kristof, the Isle Royale survey was but a testing ground. It was Kristof's intention to utilize ROVs for deep-water archaeological investigation, but in a systematic fashion, utilizing state-of-the-art sector-scanning sonar technology and/or an electronic grid system to provide precise vehicle tracking on a given site. I suggested the interfacing of a computerized system to record all digitized information provided by both the sonar tracking system and the vehicle. All that was needed was an appropriate shipwreck site at which a variety of systems might be brought together for an extended test.

I suggested the *New Jersey*, and National Geographic accepted. A three-week survey project was scheduled for February 1987, and field testing of the equipment was set for November 1986.

On November 10, 1986, the Maryland State research vessel *Discovery* carried the National Geographic ROV team, U.S. Navy technicians, the MGS, NAA, and computer engineers from the University of Baltimore to the *New Jersey* site. In order to erect a permanently positioned tripod mount for the sector-scan sonar unit, testing of bottom sediment consistency was first undertaken. Then a temporary tripod was erected within the wrecksite by divers. Following the tripod deployment and mating with the sector scan sonar unit, a Mini Ranger Mark II ROV was launched and successfully tracked throughout its entire flight. Many experiments were undertaken. Measurements of representative sections of the site, for instance, were taken using only the sonar cursor. These will be tested for accuracy by divers during the actual field work in February, and checked against a permanent electronic grid that will also be erected on the site at that time.

All field testing utilizing the ROV and sonar proved totally positive and, in fact, several important discoveries were made. In the course of the very brief investigation, it was observed that the boiler had apparently experienced an explosion. Details of the stem construction, such as a carved stem post, not noted before, were recorded, and hours of video record of the site, with excellent provenience, obtained.

The February 1987 remote survey of the *New Jersey*, it is hoped, will not only provide the largest assemblage of data possible about that site in the least amount of time, but it will also seek to develop techniques of robotic excavation, survey, and sampling of a submerged site that is cost-effective, safe, and free of environmental concerns. It is hoped that the data assemblage will be suitable for limited wire model computerized reconstruction of the site itself. Diver activity will be minimal and will primarily consist of a one-time deployment of buoys, tripod, a daily deployment and retrieval of the sonar unit head, and plugging in the electronic grid lines to onboard power sources.

As for the long struggle to institute a management plan of Maryland's Submerged Cultural Resources, positive results are being produced. In late 1985 funds were granted by the Maryland Historical Trust to the Maryland Geological Survey to begin an intensive literature search and the compilation of a site inventory list. Last fall, funds were again released for a 1987 program of field proofing of the inventory data. And in late November 1986, following the ROV field testing in Chesapeake Bay, a move was introduced by the Maryland Highway Administration to secure funding for a limited but ongoing Maryland State underwater archaeological program. It is expected that, following the February survey, *New Jersey* will be nominated to the National Register of Historic Places.

DONALD G. SHOMETTE
NAUTICAL ARCHAEOLOGICAL ASSOCIATES, INC.
9110 GRANDHAVEN AVENUE
UPPER MARLBORO, MARYLAND 20772

HOWARD B. TOWER
JAMES J. MILLER

The *Widgeon*: A New View of the Saint Marys River During Reconstruction

The Saint Marys, a tidal blackwater river which drains the Okefenokee Swamp in Southeast Georgia, meanders 175 miles through forest and marsh in an easterly direction to the Atlantic Ocean. Jean Ribault, French explorer and colonist, was the first European to discover this waterway in 1562. Following Pedro Menendez defeat of the French in 1565, the Spanish established missions which lasted into the seventeenth century on barrier islands adjacent to the river's mouth.

Britain acquired Florida from Spain in 1763 and encouraged citizens to settle along the Saint Marys. Plantations were established, and, using slave labor, crops of rice, indigo and cotton flourished in conjunction with a primitive lumber industry. The Revolutionary War slowed the region's economic growth, and the Treaty of Paris in 1783 brought Florida again under Spanish domination. British colonists, unwilling to swear allegiance to either America or to Spain and the Catholic Church, abandoned their plantations on both sides of the river.

However, in the 1790s, Spanish Florida and the State of Georgia recognized the Saint Marys as both a natural boundary and an unsecured deep channel waterway. Each encouraged citizens to

settle along its banks. Spanish authorities, in an unprecedented act, allowed non-Catholics to own property, and the seeds for economic growth during the next century were planted. The following chronology of events at Brickyard Landing on the river's Florida side is representative of the region's historical development.

Shortly after 1790, an unknown individual farmed land at a location he called Sandy Bluff. Prior to 1803, he abandoned his property which was then settled by Burroughs Higginbothman and his wife Esabela. Adjacent to this property, Spanish authorities granted land to an Enrique Gilbert for the manufacture of brick. By 1830, this bluff along the St. Marys was known as the Brickyard. During the 1840's, Samuel Swann of North Carolina purchased the Brickyard and furnished brick for the construction of Fort Clinch on Amelia Island at the mouth of the river. His enterprise flourished until the Civil War brought destruction to industry and property along this waterway.

Union gunboats visited the St. Marys numerous times. The destruction in 1863 of Woodstock Mills, a sawmill town, exemplifies the personal suffering endured by residents along the river. As Federal vessels steamed toward their objective, they passed the Brickyard, reduced to rubble by earlier military activity. The Civil War shattered the region's economy, leaving property owners destitute.

Records of post War reconstruction activity are sketchy. Historian Samuel Clark Hood, in his book, The St. Marys - A River of Turmoil, summarizes events during the period 1865 to 1875 by stating that a sawmill, owned by the Mizel brothers, was erected at Kings' Ferry in 1866, and property owners formed business alliances with newly arriving Northern investors.

A national and worldwide demand for lumber and associated byproducts in the mid 1870's triggered an economic revival along the St. Marys, as dozens of sawmill communities sprang into existence. And the docks at Brickyard landing were used by the owners of Lessie, a turpentine center, to ship rosin to Fernandina. In 45 years, the virgin forests were depleted, the sawmills dismantled, and nature slowly began to reclaim the land. Today the St. Marys appears much as it did prior to the Revolutionary War. But clusters of rotting pilings, scattered along its length, give mute testimony to the river's tumultuous past.

On August 4, 1984, scuba divers Howard Tower, Jim Lee, and Paul Hart visited Brickyard Landing to search the adjacent submerged bottom land for archaeological resources. In the course of their dive, they discovered the remains of a vessel lying parallel to the shore at the channel edge in 10 feet of water and listing sharply to one side. Tower, who had archaeological training through the programs administered by the South Carolina Institute of Archaeology and Anthropology, believed this wreck to be historically significant. All agreed to keep the discovery secret.

Six months earlier, Tower had visited archaeologists at the Division of Archives, History & Records Management (now the Division of Historical Resources) in Tallahassee, Florida and discussed the need to establish working relationships with divers exploring State waters. Based on the Division's interest in attempting a pilot project, Jim Miller, State Archaeologist, was advised of the discovery by telephone.

During the following week, the divers conducted a reconnaissance of the wreck to collect data. The vessel proved to be a steamer with an iron screw and drive shaft in place. Boiler(s) and associated machinery were missing, but an iron casting inscribed "Brown Brothers Chicago" with patent dates of 1846 and 1855 was recovered. The ship suffered an extensive fire as evidenced by charred timbers throughout the wreck and quantities of melted glass, brass and copper. The exterior hull was sheathed in copper and ceiling planks covered the frames within the vessel. Her bow pointed upstream and she listed 50 degrees to starboard. Sediments of mud and sand six to twelve inches deep covered the bow and starboard side. The stern and port side were completely exposed and virtually free from sediments. The wreck was estimated at nearly 80 feet in length with a beam exceeding 10 feet. Visible brass fittings were strong evidence that the site had not previously been explored by divers. Tower transmitted this information to Miller and asked permission to excavate the vessel referred to as "The Brickyard Wreck."

Miller agreed to monitor a controlled excavation and prepared a set of archaeological guidelines to govern all phases of the project. These included establishment of a site grid of five foot squares oriented by permanent datums, detailed procedures covering the removal of cultural material, its subsequent cataloging and storage, and a structured format for recording data.

Newly enacted state law mandated a permit from the Florida Department of Environmental Regulation to remove sediments covering the wreck. Tower applied for, and received, the first such permit issued in Florida. As the salvage contract moved through departmental channels, the divers established a site grid and collected structural data concerning the wreck. A fourth diver, Larry Tipping, joined the team. Tipping, a long-time diving associate of Tower, had archaeological experience excavating the USS Boston, a Civil War wreck in South Carolina. At this time, the Atlantic Alliance agreed to sponsor the project.

The site is covered by fresh tannin water virtually free of suspended particulate matter. Because of its close proximity to shore, generally less than 25 feet, tidal currents are mild. Underwater visibility is three feet with a light.

The remains of the vessel measure 66 feet 8 inches in length and 14 feet across at mid-ships. The iron screw, missing one blade, is 6 feet in diameter. The ship was small but of first class construction as evidenced by her hull. Strakes two inches thick and six inches wide are covered with tar and animal hair to which overlapping sheets of copper are secured by one inch brass nails spaced 3 to 4 inches apart. Below the waterline, strakes are pinned to the frames with 6 inch brass nails, and wrought iron fittings are used elsewhere. Frames 4 inches by 8 inches are uniformly spaced at intervals of 15 inches. Ceiling planks, one inch thick, cover the ship's interior framework. Her keelson, measuring 50 feet, is 6 1/2 inches wide but varies in height from 6 to 8 inches. Iron pins 1 1/4 inches in diameter, spaced at intervals of 18 to 20 inches, fasten this timber to the hull.

Salvage contract S-30 was issued to Howard Tower on May 14, 1985. Ping pong paddles and a water jet powered by a 3 HP gasoline engine were used to remove sediments covering the wreck. As expected, cultural material was concentrated on the starboard side or had settled to depths of 4 to 8 inches in the river bottom adjacent to the vessel. Only loose material was recovered so that the wreck would remain structurally intact for future study.

Every grid square was numbered, and excavated artifacts were transported to the surface in large plastic baskets lined with nylon mesh, then cataloged in the following manner. Objects of similar composition and size were listed and described on a form containing the coordinates and number of the square excavated, then assigned a catalog number. This number was inscribed with waterproof ink on plastic tags which were placed in the storage container with the excavated material. Self-sealing sandwich bags were used to store small objects, and large, heavy duty trash bags were used for bulky or heavy items. These containers allowed excavated material to be kept wet at all times.

After each excavation, a field report was sent to Miller's office, and from time to time, agents from the Division visited Tower to review records and discuss the status of the project.

The excavation was finished October 5, 1985 and resulted in recovery of 2746 objects, including hundreds of pieces of broken china and crockery, tools, brass fittings, flatware, keys, door locks, clockworks, buttons, shoes, lamp fixtures, and quantities of melted lead, copper, brass and aqua and amber glass. Primer paint was visible on many iron fittings. Clearly this vessel was engaged in commerce at the time of its destruction, but no evidence of cargo was found.

As the excavation progressed, the divers began to research the vessel's identity. A local steamboat historian in Jacksonville reviewed the wreck's structural data and suggested she was the Martha, a packet steamer lost in 1893. Aqua and amber glass, recovered during the excavation, is common to that period. But a Civil War era US Navy button and flatware crafted during the mid-19th century suggested an earlier date. Tower thought these items might be heirlooms or remains thereof.

The entire assemblage of cultural material was transported to Tallahassee along with scaled drawings of the wreck. As David Muncher of the Florida Research and Conservation Laboratory cleaned and examined these artifacts, he noted calligraphy on broken pieces of china. The letters, when pieced together, spelled *Widgeon*. Expanding his research, Muncher found the *Widgeon* listed in *Merchant Steam Vessels of the United States*, (1790-1868) compiled by William M. Lytle and Forest R. Holdcamper.

The *Widgeon*, a 56-ton screw steamer, was built at Odgensburg, New York, also her first home port. She is listed as having burned April 8, 1867, at Jacksonville, Florida. Odgensburg is situated 40 miles below Canada on the St. Lawrence River. Tower and Muncher contacted the library and a local maritime historical society at Odgensburg but found nothing concerning the ship. Federal archives reveal the *Widgeon* was not purchased or leased by any branch of the service during the Civil War.

Muncher, with Tower's assistance, explored the wreck for two days during July, 1986 and recovered the *Widgeon's* flag staff, crafted of brass and iron. Also, additional structural information was gathered. The salvors, impressed with the historical significance of the ship, donated their portion of artifacts, with the exception of four objects, to the State, utilizing provisions in the Federal Internal Revenue code.

The circumstances and events surrounding the *Widgeon's* journey to the St. Marys and her subsequent destruction, are, at present, unknown. But evidently, soon after the Civil War, this new ship, of first class construction, elegantly appointed, and propelled by the latest in steam engine technology, traveled nearly 2000 miles to the backwaters of Florida. As mentioned earlier, little is known of events along the St. Marys during the decade following the War. The *Widgeon* represented an enterprise involving great expense, energy and purpose. Perhaps continuing archival research will find the answers.

The authors are mindful of the wide range of public and professional views on responsible management of historic shipwreck sites. The *Widgeon* project was undertaken as a first attempt in Florida to establish mutually satisfactory conditions allowing amateur excavation of a single specific site. Both parties brought to this project certain reservations, along with a commitment to conduct an acceptable excavation. Tower and his associates had received prior training and experience from their work in South Carolina, and contributed many hundred hours of time in travel, diving, record keeping, and report preparation. On the part of the State of Florida, the *Widgeon* required an equal commitment of time in administration, monitoring, review, field work, artifact analysis, and conservation.

As a result of this work, the Division holds title to the complete artifact assemblage less four items, along with a set of field and analysis records that are available for future study. The *Widgeon* remains intact in the St. Marys river for further architectural study, and a small piece of the maritime history of the St. Marys River has been put in its proper perspective. During the *Widgeon* project, all the participants had an opportunity to consider in detail the rewards and difficulties of sport diver involvement in shipwreck research. On both sides, preconceptions were tested, and attitudes were changed.

In conclusion, several points may be mentioned. First, there are many classes of shipwreck sites which would be unsuited to a project of this nature. The *Widgeon's* age and the fact that she had burned and been salvaged at the time of sinking suggested that the site had moderate historical significance. Second, although it was necessary to establish detailed archaeological guidelines, the divers' past experience allowed these to be followed with little difficulty. Third, the *Widgeon* project required considerable commitment on the part of the state in personnel time, and more work remains to be done in the areas of artifact conservation, analysis and publication and eventual preparation of a travelling or locally based museum exhibit to share results with the public. While the *Widgeon* has proven to be a worthwhile project in many ways, it should be made clear that successful involvement of sport divers will require that a number of important factors be seriously considered in advance. There will be many models for participation of experienced sport divers in shipwreck management, and the *Widgeon* project has shown that there is every reason to be hopeful about continued progress in the future.

REFERENCES

HOOD, S.C.,
n.d. *The St. Marys, a River of Turmoil.* Unpublished manuscript.

JOHANNES, JAN H., Sr.,
1976. *Yesterday's Reflections—Nassau County, Florida.* Callahan, Fl., Florida Sun Printing.

HOWARD B. TOWER, JR.
3332 EMAN DRIVE
JACKSONVILLE, FLORIDA 32216

JAMES J. MILLER
FLORIDA DIVISION OF HISTORICAL RESOURCES
THE CAPITOL
TALLASHASSEE, FLORIDA 32399

BILL EDDY

Nautical Archaeology Training Program for Sport Divers

Responsible nautical archaeology divers, archaeologists, maritime historians, and conservation specialists are concerned over the destruction of submerged cultural resources by unscrupulous salvage divers or archaeologists and sport divers. This paper will describe a training program developed by sport divers and professionals in the field of maritime history and nautical archaeology. This training program is unique because it is built upon three levels of training and a strong code of ethics.

In the continuing search for new dive sites for the Capital Divers Association (CDA), historics ships were located. Contact was made with maritime historians, nautical archaeologists, conservation specialists and state staffs charged with the protection of these sites. It became very clear that special training would be needed if we were going to continue to investigate historic vessels. Universities and state staffs were used to identify the components necessary in the development of a program of study for sport divers interested in nautical archaeology. We also learned that many people were concerned over the current training programs oriented toward salvage programs and projects. It was decided that our nautical archaeology training program would not be oriented toward salvage projects (plundering or selling our nations submerged cultural resources) but would try to work in a positive way with states, local governments, or multi-jurisdictions, and martime museums. Our program would be oriented toward protecting our maritime cultural resources by conducting ethical programs and activities with responsible state agencies, local jurisdictions, historical societies, universities, and maritime museums. One of our primary objectives is to protect for the public benefit our submerged non-renewable maritime cultural resources.

Our basic rule states we have an obligation to protect historic sites. This holds true whether or not a state or local jurisdiction protects these historic site. We also determined that material from historic sites belongs to the state and nation and must not be bought, traded or sold in the market place. All artifacts in our projects are turned over to a responsible local or state agency, university, or maritime museum charged with the care of archaeological resources.

We must also realize that although some states may not have the political will (laws, policies, regulations, management practices, staff, or financial base) to protect our non-renewable and vulnerable submerged cultural resources our obligation remains the same. Historic houses, documents, dishes, Native American Indian graves and a host of other artifacts and sites are protected by a state's policies and practices such as funding of programs and activities to identify, protect and conserve cultural resources for the public benefit. The same cultural resources that are submerged or maritime in nature benefit very little from Federal or state legal or fiscal protection. The permitting of salvage projects, in which our nations submerged cultural resources are sold, not properly reported, conserved or preserved for the public benefit is a flawed practice that we must come to terms with as a nation.

The nautical archaeology program for the Capital Divers Association was developed and guided a group of members including myself and: Mr. Ellsworth Hall, Mr. Bill Robey, Ms. Arlene Reynolds, Mr. Bill Latini, Mr. Steve Nichols and Mr. Dale Fox. Professionals outside NAD who provided critical assistance were: Mr. Donald Shomette, maritime historian, Ms. Katherine Singley, maritime conservation specialist, Dr. Richard Hughes, Director of Maryland's Historical Trust, Dr. Ralph Eshelman, Director Calvert Marine Museum in Solomons, Maryland, Mr. Tyler Bastian, State Archaeologist for Maryland, Mr. Joe McNamera, Archaeologist, Mr. Alan Albright, State Underwater Archaeologist for South Carolina, Mr. Steve Bodolay, Chairman Prince William County Virginia Historical Society, Dan Lenihan and Larry Murphy, Submerged Cultural Resources Unit NPS, Jerry Livingston, Scientific Illustrator, and other maritime historians, underwater archaeologists, and conservation specialists at the university and state levels. A special thanks to Mr. Mike Freeman, owner of American Water Sports, Inc. of Maryland and Mr. Harrison Stam, owner of American Water Sports of Virginia for providing classroom and meeting facilities for NAD.

In developing the program, three levels of training were identified and put in place. These include:

1. Course one titled: "Underwater Archaeology." Four courses offered to date (10 weeks);

2. Course two titled: "An Introduction to the Conservation and Preservation of Underwater Artifacts." Two courses offered to date (10 weeks); and

3. Course three titled: "Field School on Underwater Archaeology." Two field schools offered to date (eight days), (See examples of above attached.)

Course One

Course title: Underwater Archaeology

1. Introduction: Underwater Archaeology, 1300 to present. A review of the history and development of the science of underwater archaeology. An overview of the historic importance of Maryland and Virginia waters in terms of historic ships, maritime history, projects, and present and future underwater archaeology needs of area.

2. Archives and Archaeology. Resources and research as an adjunct to historical site projects.

3. Locational Technology and Preliminary Remote Site Evaluation. The location, relocation, and mapping of underwater archaeological sites through the use of remote sensing technology and robots.

4. The Underwater Survey - Excavation. Techniques of underwater excavation, methodology, and engineering. The Reconnaissance Survey - rationale, procedures and importance of special teams, equipment, and role of sport divers, conservation specialists, nautical archaeologists, maritime historians, representatives of state and local agencies and maritime museums. Video: Turtle Shell and Tooth Key. Slides: Confederate Naval vessels, a project by Nautical Archaeology Division of The Capital Divers Association. Field conservation methods will be discussed.

5. The Underwater Survey - Photography, Photogrammetry, Robots, and Site Interpretation. Video Underwater excavation in Yassi Ada, Cape Gelidonya, Serci Limani, and a intact Four-masted vessel the Nautical Archaeology Division is conducting a reconnaissance survey of and video mapping.

6. The Underwater Survey - Artifact Recovery and Interpretation. Film: Fort Branch Preservation—a Unique Legacy.

7. Underwater Mapping (Classroom and pool exercise - hands-on). Examples of mapping (hand drawings and video), procedures used in a variety of projects in the ocean, Chesapeake Bay, rivers and zero visibility waters. Drawings and videos of artifacts and parts of vessels are presented.

8. Underwater Archaeology, Ethics, and the Law. Existing international, federal, and state laws pertaining to submerged cultural resources, and the ethics and role of the amateur and professional archaeologist relative to site studies, resource ownership, and site preservation. The benefits of working with maritime museums, universities, and state agencies are presented.

9. Ship Nomenclature. A hands-on study of wooden ship nomenclature and parts functions aboard an historic wooden sailing ship. Field study.

A final exam is given and a research paper written by each student. Upon successful completion of the above, the student receives a certificate.

Why is our training program unique? It is not just our basic course, which is similar to other courses offered, but rather our course on conservation and preservation and our field school.

Course Two

Course Title: An Introduction to the Conservation and Preservation of Underwater Artifacts

Couse Instructor: Ms. Katherine Singley, Conservation Specialist of Anthropological Sites

This course is designed to give the sport diver and archaeologist (who is generally untrained at the graduate level on the conservation of submerged cultural resources) the basic knowledge required to identify the material composition of fresh or salt water artifacts, and to choose a safe and simple method for conserving and preserving it. This course provides a wealth of information on the ethical considerations of providing information on conservation and preservation to persons who would destroy sites and sell artifacts.

The lecture emphasis of the class relates to the manufacture of materials commonly found in underwater archaeological settings and how they react to prolonged exposure to water. Once the type of material is determined (for example, metal, glass, wood, or leather), an appropriate method of conserving and preserving the artifact can be developed.

All Nautical Archaeology Division activities that deal with the removal of materials from submerged cultural resource sites are under the direction of site conservation and preservation specialists, the museum director, site archaeologist, project director, and representative of state or local jurisdiction.

In addition, the student learns how to provide temporary "field conservation" of an item at the site until a more permanent preservation method, under the direction of a conservation and preservation specialist, can be applied.

The second element of the class, the "hands on" practical application, is the key to success in learning about conservation. A demonstration of the most common material types is presented at each session. Students bring to class a "special find" or artifact for actual conservation and receive advice on treatment. Students call in advance when bringing in an item for preservation so that the instructor can be properly prepared. (Students are assigned a project that designs and constructs a conservation tool or device.) The participants are tested on this material.

Outline for the eight course sessions follows:

Lecture/Reading

Week 1
Introduction to underwater conservation. Water chemistry, marine environment, field and packing techniques, documentation, conservation alternatives, storage in the field, and ethics.

Week 2
Ceramics—fabrication, deterioration, conservation, and adhesive theory.

Week 3
Glass—fabrication, deterioration, and conservation.

Week 4
Introduction to metals and alloys, corrosion mechanisms, copper alloys—deterioration and conservation.

Week 5
Iron alloys—technology and manufacture. Iron alloys—deterioration and conservation.

Week 6
"White metals": silver, tin, lead, nickel, and aluminum.

Week 7
Wood-structure, deterioration, and conservation.

Week 8
Other organics: leather, textiles, rope, and paper.

Upon successful completion of the above course, a final exam and the assigned project, the students receive a certificate. For detailed outline of course, see attachment on conservation course or contact Ms. Katherine Singley.

COURSE THREE

Course Title: Field School on Underwater Archaeology "Site Discovery, Search and Site Survey Training in Underwater Archaeology"

The purpose of this field school is to learn how to apply the skills developed in the introductory archaeology course and conservation course. This field school provides instruction in how to safely and successfully locate, relocate, identify, survey, and map to scale historic ships or other submerged cultural resources.

Primary Areas of Training

The hands-on course includes 11 training areas: (1) overview, (2) setting up a grid on land and in the water, underwater survey and mapping, (3) underwater mapping in low and zero visibility (6 inches or less), (4) site survey techniques including land and underwater transits and pelorus, (5) use of underwater metal detectors, (6) use of underwater communication equipment, (7) use of hooka systems, (8) maintaining accurate records, (9) an introduction and overview of the need for preservation and conservation of site and artifacts, (10) use of hydro and airlift systems and (11) review of safety concerns and practices. The use of the hydro and airlift are especially important and are carefully explained and demonstrated.

This course stresses the basics of site discovery, location, scale mapping, record keeping and survey methods in recording data from historic ships. The course also stresses that diving is a science that has rules that must be obeyed.

We have learned that it is important to develop skills in a controlled environment (first four days are in quarries). In a quarry, the problems of current and entanglement are not present. We are able to practice our underwater archaeology skills at a fixed depth and in a known environment. All our diving is done under the strict guidance of SCUBA instructors. All divers are given a check out dive to make a determination of their level of diving skills and for buddy assignment. All new divers are assigned a SCUBA Instructor or our best divers as their archaeoloy dive buddy for the whole field school.

From the quarries the students are taken to historic shipwreck sites to conduct a reconnaissance survey and apply their learned skills from the class and at the quarries. The historic site (an intact vessel) is located in 10 to 15 feet of water. By going slow with the diver, we provide and opportunity for the nautical archaeology diver to get a feel of how he/she feels about diving in this kind of environment. This type of diving in the ocean, bay and inland waterways takes special training and adaptation. If the diver or archaeologist needs additional training to dive and work in these environments, the SCUBA Instructors will make this recommendation.

Field School Syllabus

Overview: Wreck and Salvage Divers vs. Underwater Archaeology Divers

The students review the differences between treasure hunting and underwater archaeology. Goals for students who complete the training: what a sport diver can do by working with local and state historical societies, maritime museums, local and state governmental agencies, clubs and special projects in the field of underwater archaeology.

1. Setting up a grid.

All students lay out a grid on land, review special tools and research methods. Students are assigned to an area and trainer (archaeologist) and assemble and set up grid over the selected site. Later, students use special tools (such as underwater metal detectors, measuring reel tapes, compass board, pelorus, underwater transits, measuring boards, and underwater communication gear) and learn special procedures to ensure minimum harm to site. This training is conducted in high and low visibility water.

The following instructional topics are explained and applied in the course:

(a) Positioning stations and datum points relative to vessel;
(b) Use of map boards—legal size plastic flip chart with grid on boards;
(c) Construction of a grid on land and in the water;
(d) Procedures to assemble grid;
(e) Transporting a grid to submerged site (use of inflatables) and positioning grid over/in site;
(f) Special features of the adjustable grid;
(g) Establishing datum point in reference to historic site.

2. Site Survey (mapping) students review class notes, read handouts, and then conduct survey of selected site or area.

The use of survey techniques, special tools, special drawing techniques and procedures are stressed. Students record and measure the site, identify archaeological artifacts within grid, survey or map and record to scale the artifacts in situ using a legal size plastic map board and acetate sheets with a #2 pencil.

(a) Review basic survey mathematics;
(b) Use of Azimuth circle (plane table);
(c) Measuring: using tape, compass, underwater and land transit, pelorus, and theodolite;
(d) Air level and ranging pole for horizontal and vertical measurements;
(e) Obtaining elevations (stadia rod/alidade, ranging pole);
(f) Magnetometer surveys;
(g) Metal detector surveys;
(h) Photo mapping;
(i) Remote sensing gear.

3. Excavation and its Role in Underwater Archaeology

The following excavation techniques are stressed. A conservation and preservation specialist, archaeologist and Master SCUBA Instructor will be in charge of area A to F.

(a) The hydro lift;
(b) Air lift;
(c) Fanning;
(d) Blowers, propwash will be reviewed
(e) Lift bags; and
(f) Special tools.

4. Hydro lift.

The proper use of the hydro/air lift in underwater archaeology will be explained. SCUBA Instructors with a hydro lift trainer/operator and a rescue diver work with students. All students have an on-land demonstration first on the features and safety concerns when using this equipment; roles of SCUBA Instructors, tenders, safety divers, and trainers are presented. Diving depth for hydro training is set at 8 to 15 feet.

5. Airlift

Repeat above teams for Hydro/lift. Diving depth for airlift is 35 feet and multiple instructional staff if used because of the depth.

6. Hooka System (surface supplied air) Similar team for Hydro lift used here

Presentation of hooka systems and their role in underwater archaeology programs in remote sensing areas is presented. Use of hooka, safety information, mechanics of unit, care of unit, and communication. Self-rescue drills on land and then in water are a must. All persons using a hooka system must wear a complete backup SCUBA system during the training and on the nautical archaeology reconnaissance surveys.

During the mapping or other training, all students using a hooka wear a complete SCUBA system with a back-up octopus or a "pony bottle" with a regulator. This is critical, as students are working in good to poor visibility depending on the training site. No one is allowed to dive with a single air supply.

7. Use of Metal Detectors

Students have hands-on demonstration of this very useful tool. An on-land introduction is used to show students how to locate artifacts. The students then proceed to the water course and work within a grid to locate finds. Students learn the benefits of audio units that work best in poor visibility conditions. The location of finds is done by:

(a) In high visibility: by sight reading and sound; and
(b) In low visibility: detection by sound only.

8. Underwater mapping, measuring, and reconnaissance surveys in zero visibility (less than 12 inches) or other poor conditions

(a) Underwater measurements in poor to zero visibility;
(b) Surveying in poor to zero visibility;
  1. Use of buoys to mark site/artifacts/vessel; and
  2. Transit and pelorus use on land/submerged site.
(c) Underwater Communication - manual and electronic means;
(d) Special precautions to be taken by divemasters, safety divers, rescue divers, and archaeology divers in low visibility;
(e) Photo/video work in low visibility;
(f) Site location and site identification methods;
(g) Role of underwater archaeologists, conservation specialists, recorder or data, and site researcher; and
(h) Role of Project Director, Lead Divemaster, divemasters, and rescue divers are presented.

9. Underwater Communication (manual and wireless electronic)

Communication between divers is critical under any conditions and especially so when diving under poor conditions. All divers are provided instruction on diver to diver, surface to diver, and diver to surface communication. The reason for including wireless underwater communication equipment is to increase our ability to obtain better data and enhance diver safety.

10. Preservation and Conservation: Ms. Kate Singley

Conservation practices, related care of artifacts, and the ethical treatment of historic sites and finds is presented.

The importance of including conservation and preservation specialists in the design of a project from the very start is discussed. Examples of what can happen to artifacts that have not had the required care is presented. Students are trained in leaving an artifact in place till the following determination is made: The location of the find is recorded; mapped in and drawn to scale in situ; permission to remove is granted by the project director, archaeologists, or conservation specialists, museum or local governmental agency representative; a conservation plan is developed at the site and with the assistance of a conservation specialist, a determination is made as to who will perform the followup conservation and preservation if further special conservation and preservation care will be required, and whom will take final charge of the find. If the proper conservation methodology can not be put in place, the artifact will be reburied deep in the mud and the location recorded.

11. Recordkeeping and the Scientific Method of Conducting an Ethical Archaeological Project

A presentation is made on the importance of keeping acurate records and using the correct scientific methods in order to have a recognized project that will be reportable and of value to the Nautical Archaeology Division, historical society, university, State or museum.

Day-by-day description of activities at field school

For an understanding of a day-by-day description of instruction activities at the field school, see attached materials.

Qualifications of Persons to Take Part in Nautical Projects

One of the major weaknesses of nautical archaeology projects is that participation of sport divers or archaeologists is not always based on the needed training. Using people because of their special skills in a needed area (a person has a boat, a video camera, is a SCUBA instructor, is a divemaster, owns a dive shop and will provide air and diving equipment, or is an archaeologist) does not mean that they have had training needed to make a positive contribution to the project. Telling sport divers about the site could result in damage to the site if the divers are not trained or unethical. The above practice of using anyone you can get in order to get the job done is unethical.

Archaeologists who do not recognize diving for the science that it is, and have not made the investment in needed SCUBA training and equipment, put themselves and the whole project at risk. We feel that the Nautical Archaeology Division's training approach is headed in the correct direction. All persons in our projects must have had at least the basic introductory and field school course to qualify to work on a project. Over a period of time, one becomes familiar with the strengths and weaknesses of individuals: one may be likely to prematurely divulge special information about the site, their poor attitude on protecting artifacts puts the artifact at risk; how they follow objectives for each day at the project; how they apply safe diving practices in their approach to their dive buddy and assignment, or do anything that would bring harm to the site (writing stories that draw attention to the site or telling others of the site's location). This last behavior will lead to a "path of destruction at a historical site.

Because a person has had the nautical archaeology training or is an archaeologist does not mean that they are qualified for the conditions of the site. The decision to prevent a person from diving in poor conditions is left to the safety officer and the SCUBA instructors. We

have found that there is a role for all who wish to contribute whether in recording data, field conservation, making and maintaining equipment, conducting research or working on the reports. The fundamental traits needed is for the person to be a very good diver and have an ethical regard for the value of submerged cultural resources.

Accomplishments and activities of the Nautical Archaeology Division are:

1. Researched and developed a training program with three levels of training.
   a. Four introductory courses "Underwater Archaeology";
   b. Two introductory courses comprising "An Introduction to the Conservation and Preservation of Underwater Artifacts"; and
   c. Two practical courses constituting a "Field School on Underwater Archaeology".

2. Developed an agreement with the Historical Society of Prince William County, Virginia that allowed us to conduct an initial reconnaissance survey. We are now working with the County Archaeologist, Ms. Janet Townsend, and Ms. Kate Singley, a conservation and preservation specialist, to ensure that the artifacts, "two portholes", recovered from the site are conserved and preserved properly for presentation to the Historical Society of Prince William County, Virginia.

3. Developed an agreement with Dr. Ralph Eshelman, Director of the Calvert Marine Museum in Solomons, Maryland. This cooperative agreement calls for the Nautical Archaeology Division (NAD) to conduct "the Solomons Harbor Submerged Cultural Resources Survey." In this survey, we will be conducting a reconnaissance survey to identify historic sites. We will use special video equipment that can "see where the human eye cannot" to help us locate and record our finds. Dr. Eshelman is also an advisor to the Nautical Archaeology Division.

4. Nautical Archaeology Division divers assisted Mr. Donald Shomette in his reconnaissance survey of the impact sport divers and dive shops are having on the historic steam ship "New Jersey." This historic vessel is being plundered by sport divers and our assistance enables the state to become more aware of the condition of the site.

5. A member of The Nautical Archaeology Division, Dr. Bill Eddy, has received permission for The Professional Association of Diving Instructors (PADI) to issue the PADI Archaeology Certification.

6. Nautical Archaeology Division members have donated special video equipment to the Calvert Marine Museum. This equipment will enable NAD to conduct underwater reconnaissance surveys of the Solomons area, a four-masted sailing ship in the Chesapeake Bay, and Confederate and Union Naval sites in Virginia.

7. The Nautical Archaeology Division has trained 95 sport divers and archaeologist in nautical archaeology. We have trained two diving archaeologists and look forward to including more diving archaeologists because of the positive contributions they continue to make.

8. The Nautical Archaeology Division has built special equipment. Mr. Bill Robey, Mr. Bill Latini, Mr. Ellsworth Hall and Dr. Bill Eddy have built the equipment that includes: two underwater transits, 1 pelorus, 2 adjustable grids, 1 hydro and 1 airlift, map boards, and a special reconnaissance survey vessel that can carry 15 divers and our equipment, and special probes for conducting reconnaissance investigations in deep mud and zero visibility conditions.

9. The Nautical Archaeology Division has developed special mapping and survey skills as a result of our work in zero visibility conditions. We have included what we have learned in our training program.

Two Problem Areas Identified in Training Sport Divers

Training sport divers presents two main problem areas when it comes to diving on historic sites. One problem is "the treasure hunting attitude" where the idea of "finders keepers" concerning artifacts is very strong or this is just another shipwreck. The other problem is with a diver who has a good attitude about protecting historic sites and artifacts but who lacks training. The Nautical Archaeology Division has decided at this time to work with the diver who has a basic understanding of the importance of protecting historic sites and artifacts but who lacks training. This determination is made when the student attempts to sign up for classes, during the initial course and during the field school. We believe that by developing a good program, we can convince many individuals of the value of conserving our submerged cultural resources. If we are to be successful in our efforts to protect historic sites and work within the letter and spirit of the law, we must have an impact on the first diver population.

For information regarding the Nautical Archaeology Division of the Capital Divers Association, contact:

BILL EDDY
330 NORTH OAKLAND STREET
ARLINGTON, VIRGINIA 22203

CALVIN R. CUMMINGS

The Management of Research Programs in Marine Protected Areas

Introduction

The cultural resource research program defined herein is offered as a tool for use by managers of all Marine Protected Areas. This program has been extracted from the existing National Park Service Cultural Resource Program, United States Department of the Interior and the program now being developed and implemented by the National Marine Sanctuaries Program, National Oceanic and Atmospheric Administration, United States Department of Commerce.

It is a program aimed at providing the range of scientific data necessary for the management and operation of a Marine Protected Area or a system of areas. The basic philosophy is a "Conservation Ethic" dedicated to preserving and conserving finite, fragile, and non-renewable resources in Marine Protected Areas. All of the research aspects are directed at having the least amount of impact and effect on the resources.

The Marine Protected Areas throughout the world now exist because many nations are concerned about the marine environment. Creating Marine Protected Areas was a critical step towards insuring that important segments of the marine environment are protected for the future of mankind. Marine Protected Areas play a very significant role, through their research programs, in furthering human understanding of the sea.

The most common type of cultural resource in the marine environment is the shipwreck. Shipwrecks, as a class resource, are international in scope and nature — vessels from seafaring nations in the course of commerce and military actions end up as shipwrecks in other countries' waters.

Many shipwrecks, caused either by natural disaster or by acts of war, are considered to be "memorials" to and for those who lost their lives on those specific vessels by the country of origin. Unless within that country's own jurisdiction, these "memorials" usually are unprotected.

To have a "known" location for a historic shipwreck today is a "signed death warrant" for that resource — even the Marine Protected Areas (National Parks, National Marine Sanctuaries, and National Wildlife Refuges) are under attack.

Marine Protected Areas also have the potential of containing the most important and significant prehistoric human remains — those left in periods of lower sea levels. Submerged prehistoric remains are difficult to locate because they lack quantities of metal and do not stand above the bottom. Today's technology is sufficiently advanced to even locate some prehistoric sites off-shore. These prehistoric sites are not directly threatened by deliberate artifact recovery (they contain no treasure), but are being destroyed by coastal development, dredgings, and off-shore oil and gas exploration.

All of these types of submerged cultural resources can be found in the various Marine Protected Areas around the world. Every Marine Protected Area will likely contain remains of past human activity. All cultural resources are finite in number and are non-renewable. There are only a small number of shipwrecks from any given time period, and when they are destroyed, they are gone forever. We cannot grow a new Manila Galleon!

Being that Marine Protected Areas were created to protect the resources contained therein, it becomes our responsibility to properly manage all of the resources, both natural and cultural, contained in Marine Protected Areas.

Prerequisites

Before research programs can be considered as an aspect in the management of resources in Marine Protected Areas, there must first be a supportive management structure. Without such a system in place, any research effort may be misdirected or even useless to long term management objectives. Sound management for both natural and cultural resources requires the same basic prerequisites. Since most Marine Protected Areas were established for natural resources, these are usually well covered. However, cultural resources have been overlooked in most cases, and the necessary prerequisites for management must be developed.

A. Basic Authority

To adequately build a cultural resource research and management program first requires a basic authority. The law, regulation, proclamation, or other method utilized to establish a Marine Protected Area (or system of areas) needs to contain specific reference to the cultural resources and the requirement to manage them.

B. Integration with Other Mandates

Cultural resource management in Marine Protected Areas needs to be integrated with other existing mandates. Many nations and states have laws and procedures that generally apply to cultural resources, and these must be applied in developing specific programs for Marine Protected Areas. Care must be taken to consider other mandates that interact with cultural resource activities — such as endangered species protection.

C. Planning System

A formal planning system usually exists by which all activities for a marine protected area are defined. Cultural resource functions need to be included in this planning system to insure proper consideration in all aspects of operations and management.

Master Plan: The single most important planning document for a Marine Protected Area is some form of master plan or General Management Plan that defines the purpose, objectives, scope and limits of that unit. Such a document is the "blueprint" for all management and operational functions of a Marine Protected Area.

Cultural Resources Management Plan: The second critical planning document for a Marine Protected Area. This defines the multi-year programming and action schedules for needed activities to preserve, perpetuate, manage, interpret, and appropriately use the area's cultural resources.

D. Programmatic Framework

To adequately manage the resources within a Marine Protected Area requires that a program structure be established. This is achieved through a set of written policies, regulations, standards, guidelines, and procedures. These clearly define the goals, objectives, and limitations that apply to all activities in a Marine Protected Area. Documents that would compose this programmatic framework include:

- Cultural Resource Management Policies
- Cultural Resource Management Standards
- Cultural Resource Management Guidelines
- Cultural Resource Management Procedures

Developing the Research Program

ONLY AFTER ALL OF THE PREREQUISITES ARE DEVELOPED AND IMPLEMENTED, SHOULD ANY EFFORT BE MADE TO DEVELOP A RESEARCH PROGRAM.

General Considerations

Archaeological studies are necessary components of a wide variety of Marine Protected Area activities including planning projects, development projects, protection, maintenance, operations, and interpretation. Archaeological studies also often are undertaken independently, for resource management, preservation, and interpretation.

Archaeological studies are divided into five general types. For specific projects or activities, archaeological studies that combine two or more of these general study types or aspects of them, may be appropriate. The scope of work, justification, and research design for each specific archaeological study will describe and justify the particular purpose, methods, and techniques that are to be undertaken (see the "Guidelines for Studies" in Appendix A for details on justification and research designs).

Each archaeological study must be planned carefully. In the planning, seven general aspects of the study should be considered especially carefully: research design, fieldwork analysis, reporting, curation of collections and other data, interpretation and other necessary permits.

EVERY ARCHAEOLOGICAL STUDY SHOULD PROVIDE ENHANCEMENT OF THE PUBLIC UNDERSTANDING AND APPRECIATION OF THE RESOURCES STUDIED. Various means of achieving this exist, including public lectures and slide presentations, newspaper articles, pamphlets, displays, and exhibits. The interpretation efforts should be coordinated with the park and regional office interpretation divisions. The best arrangement is likely to be an interpretive product done in association with the interpreters.

Archaeological Overview and Assessment

The purpose of this kind of study is to describe and assess the known and potential archaeological resources in an area. The overview reviews and summarizes existing archaeological data, and the assessment evaluates these data. This is a comprehensive synthesis of data concerning the archaeological resources of a Marine Protected Area. It is an evaluation of past work and the first step in designing future research. This study includes sections describing the natural environment, the cultural history, ethnographic occupation, description and evaluation of the past research, knowledge of archaeological resources, location of collections, relevant future research topics and possible methods, field records and archives usable for future research, and bibliographic references. Overviews and assessments are framed in a regional context and may be a part of a multiagency regional planning endeavor. They should be sufficiently thorough to serve as a basis for evaluating the significance of resources within the Marine Protected Area and for formulating research designs for other studies.

"An overview and assessment is a study carried out for general management programs. For this study, present knowledge is gathered, evaluated, and analyzed to make general statements regarding the nature, distribution, and significance of the resources in a generalized sense. Recommendations for future research and predictions of potential impacts on the resource base are made."

Overview and assessments should contain an abstract, management summary, introduction and description of the study, effective environment, research goals and strategy, methods of data collection and analysis, summary of current knowledge, evaluation of current knowledge, assessment (of known or predicted resources), management options, research tools available and recommendations.

Identification Studies

The purpose of Identification Studies is to discover the locations, and some of the characteristics of all or of a sample of archaeological resources in a particular Marine Protected Area. Identification Studies might be limited to the discovery of one or a few types of archaeological resources (e.g., historic vs. prehistoric; sites with structural components vs. nonstructural sites) if the study goals justify such an approach. Identification Studies frequently are linked closely to evaluation studies because for many interpretive and management concerns resource evaluation is equally as important as resource identification. Special site discovery techniques such as aerial remote sensing may be needed in certain situations.

Identification of submerged (underwater) resources requires special expertise such as knowledge of geomorphology and special conditions such as use of magnetometers and side-scan sonar and subbottom profilers. Background research should include a documentary search of pertinent shipping records. Identification or predication of prehistoric submerged resources may require the assistance of geophysicists or geomorphologists to determine the nature of post-Pleistocene geological processes. Identification efforts in submerged areas should be conducted by personnel experienced in dealing with submerged archaeological resources.

Subsurface archaeological remains and sites, those buried in the sea bottom under coral, sand, or sediment, frequently require subsurface tests of be evaluated. A wide variety of subsurface testing techniques are available. The expected characteristic and distribution of subsurface remains must be considered carefully in order to select the most effective and efficient technique(s) to solve a particular discovery problem.

Identification Studies can be designed to discover all types of archaeological resources throughout an area. For small areas this approach can be both the best for resource management and the most efficient. When large areas must be studied, however, a sampling approach is likely to be more effective for resource management and more efficient.

A. Sample Inventory

The purpose of a Sample Inventory is to discover the locations and some of the characteristics of a sample of the archaeological resources in a Marine Protected Area. The sample might be all of the resources in a limited area, all of a few particular types of resources in a large area, or some combination. The descriptions and justifications of specific sample designs are included in the research design for specific studies.

Sample Inventory Studies include the following elements:

-clear delineation of the boundaries of the area or areas investigated and the sampling and site discovery techniques used;
-clear description and justification for the sampling and site

discovery techniques used;
- clear description of the types of resources sought, and those discovered;
- estimate of the adequacy of survey coverage;
- record of the precise location of all archaeological resources identified.

If the Identification Study is combined with an Evaluation Study, sufficient information is needed on the type, size, nature, and integrity of each property to permit an evaluation of its significance and research potential and, if necessary, to recommend the most appropriate management strategy and treatment.

B. Complete Inventory

The purpose of a Complete Inventory is to discover the locations and some of the characterics (e.g., approximate size and structure and a sample of the common artifact types) of all of the archaeological resources in a Marine Protected Area. There may be questions about whether any study, no matter how intense, can identify all the possible resources. For the purpose of this definition all resources are considered to be the sea bottom and subsurface distributions of artifacts and features that are reasonably expected to occur in the study area.

Identification Studies designated to result in Complete Inventories must include intensive enough discovery techniques to locate even small sites with nondense artifact distributions. Intensive discovery techniques should be applied evenly across a study area so that sites in each portion can be discovered.

The only difference between a Sample Inventory and a Complete Inventory is that the former involves the collection of information from only a portion of the total unit area, or focuses on only a subset of all the archaeological resources while the latter involves the total unit area or complete universe of resources.

Complete Inventory Studies include the following elements:

-clear delineation of the boundaries of the area or areas investigated;
-clear description of the types of resources sought, and those discovered;
-clear description and justification for the intensive, and detailed identification methods and techniques;
-record of the precise location of all archaeological resources identified;
-the Identification Study is combined with an Evaluation Study, sufficient information on the type, size, nature and integrity of each site to permit an evaluation of its significance and research potential and, if necessary, to recommend the most appropriate management strategy and treatment.

C. Inventory Reports and Cultural Sites Inventory Forms

The reports that are generated by both types of inventory studies should be similar. An outline of these reports with some description of specific sections is presented below. The data needed include an abstract, management summary, introduction and description of the study, effective environment, research goals and strategy, methods of data collection and analysis, data description and analysis, and evaluation of past research.

Each inventory study is likely to result in the identification of archaeological sites. For each site, an inventory form must be filled out and added to the total inventory of the Marine Protected Area. The locations of the newly identified sites must also be added to the archaeological base map for the Marine Protected Area, and the Inventory Report added to the Marine Protected Area archaeological bibliography. On the same base map, the areas that were tested and the intensity of the testing for the inventory study should be noted.

Evaluation Studies

The purpose of an Evaluation Study is to collect sufficient data and conduct sufficient analysis of the data to determine the significance and importance of the archaeological remains under study. Evaluation Studies frequently are linked with Identification Studies. Any such dual purpose study would be described and justified in the project research design.

Evaluation Studies also should aim to determine the integrity of archaeological resources. Evaluation of archaeological resources is intended to define which resources and classes of resources are important and which attributes of those resources make them important.

Evaluation efforts should be based upon an explicit set of attributes or factors, derived from the research design of the evaluation study. Evaluation of resources also requires knowledge of the broader historic context of those resources, including their scientific, cultural and associative values at the local, regional, and national levels.

Archaeological testing for evaluation purposes should be kept to a minimum and not proceed beyond the point of providing sufficient information for determination of significance and importance and to meet the requirements for management purposes.

Values and attributes of the resources which make them important to a Marine Protected Area should not be inadvertently damaged or destroyed during the period of evaluation.

Data Recovery Studies

DATA RECOVERY STUDIES SHOULD ONLY BE UNDERTAKEN IF SIGNIFICANT ARCHAEOLOGICAL RESOURCES MUST BE DISTURBED OR CANNOT BE MAINTAINED IN SITU. Archaeological resources should remain in situ whenever possible. In some instances, however, significant resources may have to be destroyed in order to accomplish major mission objectives, such as essential operations, development or interpretation, that have greater importance overall. Then too, significant resources may be impacted or destroyed by natural or other human forces. Any such destruction or loss of significant resources must be fully recognized and reviewed. The adverse impact of this destruction may be mitigated by collecting and analyzing data from the resources that are to be destroyed, disseminating these data in a report, and preserving the archaeological collections, field notes, and other records. Data Recovery Studies are designed to mitigate specific adverse impacts.

Data recovery programs are based on the premise that archaeological resources are important wholly and partially because they can contribute to the study of important research problems. Adverse effects, therefore, can be mitigated by recovering data to address these research problems. Research problems provide the justification for selecting particular archaeological sites for data recovery.

Archaeological resources should be selected for data recovery based on their potential to provide data relevant to important research problems or management needs. The potential of properties to provide data suitable for addressing particular research problems or management needs should have been determined through overviews, surveys, and preparation of research designs during the identification and evaluation studies.

Data recovery should be conducted within an appropriate interdis-

ciplinary framework. Relevant information from related disciplines, such as marine biology, history, geography, soil science, and others, should be consulted. Excavation should not proceed until other research which will provide information to guide and limit data recovery activities has been conducted.

Data recovery programs should provide specific and regular feedback to participants. The approach and progress toward addressing the important research problems should be reevaluated regularly and systematically based on currently available data. Data recovery priorities and approaches should be revised as necessary.

Data recovery field strategies should be selected to ensure collection of data needed to address the designated research problems and to gather baseline data needed to address future research problems. The selection of strategies should be supported by the success of similar strategies with similar resources in other projects.

Strategies should be designed to recover the necessary information at the appropriate level of investigation and be cost effective.

Generally, appropriate strategies can be designed based upon information developed during identification and evaluation studies. Occasionally, some additional testing of resources may be necessary to aid in the design of data recovery strategies. In such cases, this testing should be restricted to the minimum necessary. A phased data recovery program may be cost-effective in these instances, allowing for termination or work if the resource cannot provide data pertinent to address the designated research problems. A phased program may also be appropriate when dealing with large, complex resources or groups of resources, allowing for changes in field strategy or emphasis, or termination of the program, based on an analysis of data recovered at the end of each phase.

Archaeological Collections and Other Nonfield Studies

Another kind of archaeological study involves the description or redescription, analysis or reanalysis, of collections or other data that we've collected at some point in the past. Increasingly, archaeologists are turning to such collections and archival data as advances in methodology or interpretation have made studies of them seem worthwhile. As the desirability of conserving in situ archaeological resources becomes more apparent, archaeological collections and archival data are likely to be reanalyzed more frequently and intensively.

These studies may aim to provide information for interpretation and management. They may lead to revisions in Overview and Assessment Reports, Identification Reports, or Evaluation Reports.

Summary and Conclusions

While the management of submerged cultural resources in many Marine Protected Areas is still in the developmental stage, the potential for furthering human understanding and scientific knowledge is as great as already realized in managing natural resources. The same management principles and scientific approaches apply to cultural resources as do to natural resources. Without knowledge and understanding of those resources, as derived through research programs, it is impossible to make appropriate management decisions.

Since Marine Protected Areas only contain two types of resources, natural and cultural, management responsibilities and operational considerations must be applied equally to both types of resources.

The Marine Protected Areas of the world, individually and collectively, have the unparalleled opportunity today to lead the world in preserving and understanding submerged cultural resources — those rapidly vanishing remains of human use of the sea over hundreds and thousands of years.

Today the opportunity; and tomorrow...?

CALVIN R. CUMMINGS
MIDWEST ROCKY MOUNTAIN TEAM
P.O. BOX 25287
FEDERAL CENTER, PARFET STREET
DENVER, CO, 80225

SYMPOSIUM

GORDON P. WATTS, JR.

A Decade of Research: Investigation of the USS *Monitor*

Location and Identification

Less than ten months after an historic encounter with the Confederate ironclad CSS *Virginia* at Hampton Roads, the Union's celebrated "Cheesebox-on-a-Raft" foundered in a gale off Cape Hatteras, North Carolina. At approximately 1:30 AM on the morning of December 31, 1862, the *Monitor* separated from her tow ship, the powerful side-wheel steamer *Rhode Island* and disappeared with a loss of four officers and twelve of her crew. The warships, accompanied by the steamer *State of Georgia* towing the newly commissioned monitor USS *Passaic*, were enroute to Beaufort, North Carolina. The *Monitor's* second sea voyage was to have been the first leg of a cruise that would take the ironclad to Charleston, South Carolina to participate in an assault on Confederate fortifications defending the harbor.

On August 27, 1973, an interdisciplinary scientific party aboard the research vessel *Eastward* located the heavily damaged remains of the sunken ironclad approximately 16 miles south-southeast of Cape Hatteras. The location and subsequent identification of the vessel was the result of a two-week research project supported by the National Science Foundation, Duke University, the North Carolina Division of Archives and History, Massachusetts Institute of Technology, the University of Delaware, the National Geographic Society, and the United States Army Reserve. The investigation combined both geological and archaeological objectives. The first of these was a geomorphic investigation of a ridge and swale feature located on the Continental Shelf 12 miles south of Ocracoke Inlet. The second objective was to explore the potential for adapting oceanographic tools for the location and identification of deep water shipwreck sites on the Atlantic Continental Shelf (Watts 1975 a).

Because of time and geographical considerations the decision was made to limit the scope of the second objective to the location and identification of one specific, historically documented sinking in the vicinity of the geomorphic study. While historical research revealed a variety of well-documented sinkings in the area immediately south of Diamond Shoals, only the USS *Monitor* represented a site of considerable historical and technological significance. The vessel's pivotal role in the development of naval technology and warfare has been widely accepted as symbolic of the end of the era of the wooden, sail-powered, ship-of-the-line as the citadel of sea power. The *Monitor's* unique turreted design was the first comprehensive response to the technological innovations that would revolutionize both naval architecture and warfare at sea during the Nineteenth Century (Watts 1975 b).

Additionally, the historic ship's brief career had a profound effect on warship construction in the United States. Throughout the Civil War the construction of larger, more sophisticated versions of the USS *Monitor* represented a substantial portion of Union warship production. Even in the post war years when European naval powers were concentrating on the development and construction of large seagoing armored vessels, the United States clung tenaciously to the "monitors" as the primary weapon in its declining naval arsenal. Because of its unique design characteristics and historical significance, the USS *Monitor* was selected as the objective shipwreck investigation. (Watts 1975 b).

As ship time was limited, it was necessary to accurately determine the most probable location for the shipwreck. Localization of the search area was a critical factor in determining an effective and functional systematic search pattern. To accomplish this a comprehensive effort was made to locate and evaluate all of the historical data related to the loss of the *Monitor*. While contemporary records consistently indicated that the ship was lost south of Diamond Shoals, several previous attempts to locate the vessel had concentrated on an area immediately north of Cape Hatteras. While work in the area resulted in several claims to have located the wreck, no evidence to confirm the discoveries was ever presented. As research failed to confirm any of the claims, that area was eliminated as a potential location for the survey (Watts 1975 a).

In spite of numerous inconsistencies and frequent navigational discrepancies, contemporary naval records provided the only credible source of data related to the loss of the *Monitor*. Of those available, the deck logs of the USS *Rhode Island*, the *State of Georgia*, and the USS *Passiac* proved to be the most valuable. These records preserved basic information regarding speeds, headings, and occasional positions which made replotting of the USS *Monitor's* final voyage possible. Equally important, they contained a meticulous record of wind direction and velocity, barometric pressure, and water temperature. This information made it possible to reconstruct environmental conditions during the voyage. Additional useful information was found in the records and correspondence of the captains and crew of both the USS *Monitor* and the USS *Rhode Island* (Newton and Watts 1979).

By combining this information with current bathymetric data and what was known of the influence of the Gulf Stream, it was possible to calculate a maximum and minimum potential effect for each of the variables suspected to have been responsible for the frequent time, distance, and position discrepancies in the deck logs. While it was possible for strong local magnetic disturbances to have also influenced these errors, no satisfactory method for gauging their influence could be determined. Reconstruction of the environmental conditions made it possible for critical set and drift to be estimated during the critical period after the USS *Monitor* and *Rhode Island* separated (Newton and Watts 1979).

Additional adjustments were made to compensate for the natural annual variation in magnetic north and the mid-nineteenth century location of the Cape Hatteras Light. After consulting an 1857 chart for additional bathymetric data, the information was plotted on a series of Coast and Geodetic Survey charts of the North Carolina coast. The result was a five mile by fourteen mile rectangle. Although new information on area current patterns gathered during the cruise made revisions necessary, the technique proved to be of considerable value in isolating the search area (Newton and Watts 1979).

During survey operations in the search area a total of twenty-two wreck sites were located. This was accomplished using a combination of conventional vertical sonars, a directional hull-mounted sonar, and a 100KHZ EG&G dual side scan sonar. A Varian proton precession magnetometer was also employed to identify and assess target signatures. This combination provided both an indication of the magnetic intensity of each target and an acoustic indication of physical dimensions and characteristics. In the area of the search a hard, relatively stable, and almost featureless sand bottom provided ideal conditions for both acoustic and magnetic remote sensing. Wreck sites identified by sonar and magnetometer were located using both loran and a Del Norti radar ranging system with transmitters located on the Cape Hatteras Light and Diamond Shoals Tower (Watts 1975 a).

Shipwreck signatures were evaluated according to acoustically defined features, length, relief, and the intensity and duration of their magnetic signatures. Those which obviously did not conform to the projected characteristics of the *Monitor* were recorded and eliminated from additional consideration. Those corresponding to the *Monitor's* hypothetical signature characteristics or smaller in length, relief, and magnetic intensity were examined further with a 35 mm EG&G oceanographic camera and a low light level, closed circuit television. Permanent television tape records were made on a 1-inch IVC recorder (Watts 1975 a).

Of the twenty-two sites located during the investigation, only two generating magnetic and acoustic signatures that corresponded with a projected signature for the *Monitor* were examined visually. The first of these was identified as a modern patrol boat and eliminated from additional consideration. The second, although badly deteriorated, exhibited several features that corresponded closely to known details of the Monitor's construction. Most immediately apparent was the existence of a distinct overlapping lip that closely resembled the armor belt of the ironclad. Several camera passes also recorded a cylindrical feature partially obscured by the vessel's hull. Preliminary measurements of the structure made from the television monitor confirmed that it corresponded in size to the specifications of the *Monitor's* turret. This evidence was considered sufficient to merit spending the remainder of the cruise collecting additional data at the site (Watts 1975 a).

The majority of the data collected during the R/V *Eastward* cruise was in the form of random photographic and video tape records. Analysis and identification of the sites proved to be a cumulative process. First, small photomosaics of the significant features of the wreck were constructed. These were carefully related to drawings of the site that were produced from the video tape and photographic data. This technique tied the individual camera passes together in the form of a composite picture.

While Ericsson's correspondence indicated that the specifications of the vessel were the subject of almost continuous adjustment, the external design and basic features of the *Monitor* remained essentially unaltered. By relying on the sources either directly involved in the construction or actively engaged in the operation of the vessel, it was possible to establish a reliable framework for comparison of the historical and shipwreck data. Detailed analysis of available historical source material confirmed that the design of the *Monitor* remained unique even among the later classes of turreted, heavily armored, low freeboard vessels that were built in the United States. Although many of the characteristics that combined to make the *Monitor* unique were utilized in later vessels, their designs were unquestionably altered from the original design. This comparative historical analysis isolated a series of distinguishing characteristics that would be reliable criteria for identifying the vessel (Newton and Watts 1979).

Because of their massive construction the turret, pilot house, and armor belt were anticipated to be readily identifiable regardless of the physical condition of the site. Likewise, the vessel's unusual propeller, skeg, and rudder arrangement were considered to be reliable keys to the *Monitor's* identity. At the bow the unique anchor well that penetrated the projecting armor platform and the distinctive four-fluked anchor were singled out. It was also felt that the unusual configuration of the lower hull would prove to be a useful factor in the identification process. In an effort to save both construction time and costs, Ericsson had designed the lower hull of the *Monitor* with a virtually flat bottom, extremely hard chine, and flat sides that rose to the inside of the bottom of the armor belt. The extremely bluff bow and stern were plated radially, while the plating of the lower hull ran athwartships rather than longitudinally as was traditionally the custom. This configuration and plating technique minimized the expensive and time-consuming necessity for bending plates to obtain a more sea-kindly hull design. Although there were additional details, these criteria formed the nucleus for the visual evaluation of the site and ultimately confirmed the wreckage as that of the *Monitor* (Figure 1). The warship had rolled over upon sinking and lay upside down with the port quarter resting on the displaced turret (Newton and Watts 1979).

A second opportunity to examine the remains of the *Monitor* occurred in April 1974, when Dr. Harold Edgerton secured the use of the Research Vessel *Alcoa Seaprobe*. The United States Navy, interested in evaluating the sophisticated search and inspection capabilities of the *Seaprobe*, agreed to conduct an examination of the wreck along with several other sites identified by United States Naval Academy midshipmen during an investigation identified as "Project Cheesebox." At the *Monitor* site, *Seaprobe* cruise objectives included photographic documentation of the wreck structure and, if possible, recovery of samples from the vessel for testing and analysis.

The R/V *Alcos Seaprobe* was especially suited for the proposed investigation. Designed and constructed specifically for deep water search and recovery operations, the *Seaprobe* was equipped with computer-controlled cycloidal propellors at the bow and stern that gave the vessel a virtually unrestricted dynamic positioning capability. Search and recovery operations were carried out via an instrument pod that could be equipped with a variety of acoustic, closed circuit television, photographic, and mechanical equipment. Attached by 4-inch drill pipe, the pod was deployed through a centerwell in the hull by and oil-rig-type derrick located amidships.

While deteriorating weather and other objectives prevented recovery of material from the *Monitor*, closed-circuit television permitted a complete and detailed inspection of the wreck. During that inspection more than 1,200 high quality 35 mm photographs and several hours of video tape were produced. Selected photographs from the *Seaprobe* investigation were utilized by the Naval Intelligence Support Center to construct a photomosaic of the entire wreck (Figure 2). In addition to confirming identification of the wreck as that of the *Monitor*, data from the *Alcoa Seaprobe* investigation permitted the first opportunity to assess the condition of the entire vessel.

Protection and Management

In an effort to provide legal protection for the remains of the USS *Monitor*, the North Carolina Division of Archives and History began to explore a limited number of statute options following confirmation of the *Monitor's* identity. Identifying appropriate protective legislation was complicated by the location of the *Monitor*. Lying in 225 ft. of water on the eastern continental shelf 16 miles South-Southeast of the Cape Hatteras Light, the wreck was outside both the 3 mile jurisdiction of the State of North Carolina and of the territorial seas of the United States. While Article II of the Geneva Convention on the Continental Shelf granted coastal nations "sovereign rights for the purpose of exploring the [Continental Shelf] and exploiting its natural resources," (Geneva Convention, 1958) the International Law Commission has made it clear that these rights "do not cover subjects such as wrecked ships and their cargoes" (Kronmiller 1982). Location also appeared to preclude the possibility of utilizing either the Antiquities Act of 1906 or the Abandoned Property Act. The Antiquities Act authorized the President of the United States to designate structures located on lands controlled by the United States as national monuments and thus property of the United States. The Abandoned Property Act

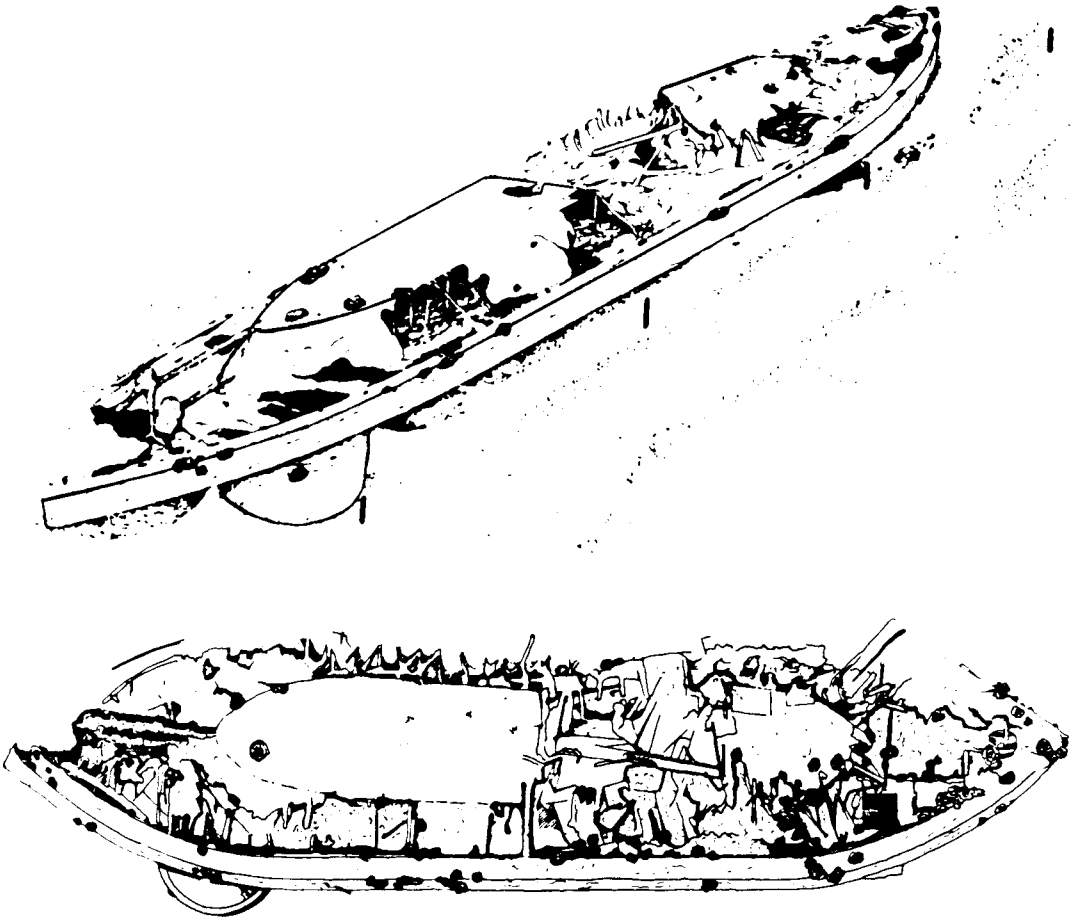


FIGURE 1. Artist rendering of the remains of USS *Monitor*

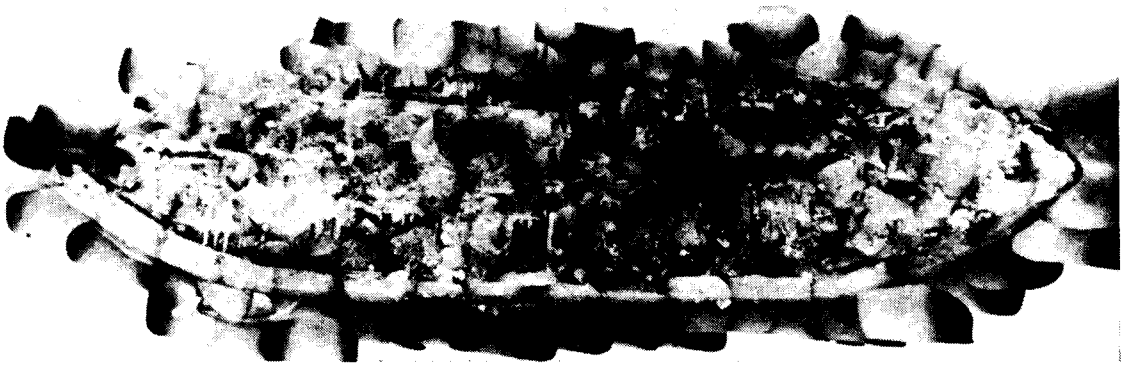


FIGURE 2. Photomosaic of USS *Monitor* compiled by Naval Intelligence Support

similarly authorized the Administrator of General Services to protect the government's interest in abandoned or derelict property "within the jurisdiction of the United States" (Antiquities Act, 1906). The application of both statutes was limited by the definitions of jurisdiction and control they contained. Protection under the Abandoned Property Act was additionally complicated by the fact that the United States Navy had formally abandoned the wreck on September 30, 1953, to clear legal barriers for a group interested in salvaging the ship and establishing a national monument (Folger, 1953)..

After prolonged investigation of potentially applicable legislation during 1974 the North Carolina Department of Cultural Resources identified Title III of the Marine Protection, Research, and Sanctuaries Act of 1972 as the most appropriate protective legislation. Known as the Marine Sanctuary Act, the statute authorized the Secretary of Commerce, after consultation with appropriate Federal agencies and with approval from the President of the United States, to designate areas of the ocean as sanctuaries for their conservation, recreational, ecological, and aesthetic values. Unlike previously considered statutes, the Congress of the United States expressly defined the extent of jurisdiction as extending to "the outer edge of the Continental Shelf." As the continental shelf extends to the 200 mile isobath, there was little question that the wreck lay within the jurisdiction of the legislation (Sanctuaries Act 1972).

In response to a request from the Division of Archives and History, the Governor of North Carolina nominated the *Monitor* as a National Marine Sanctuary on September 26, 1974. With approval from the President of the United States, the *Monitor* was designated the first National Marine Sanctuary by the Secretary of Commerce on January 30, 1975 (Brenan 1975). Establishment of the sanctuary provided long-sought protective legislation and insured that the remains of the historic ship would be managed in the best interest of the American public.

Designation of the sanctuary also delegated management responsibility for the vessel to the National Oceanic and Atmospheric Administration (NOAA). Immediately following the designation, interim regulations to govern activities in the sanctuary were developed by NOAA and published in the Federal Register. These regulations were revised in response to public and official comment and published as final rules and regulations effective May 19, 1975 (15 CFR 924).

Violation of the sanctuary, described as a "vertical water column in the Atlantic Ocean one mile in diameter extending from the surface to the seabed, the center of which is at 35 00'23" north latitude and 75 23'32" west longitude," was to carry "a civil penalty of not more than $50,000 against any citizen of the United States for each violation of any regulation...." The regulations further authorized "proceedings in rem against any vessel used in violation" of sanctuary regulations. With the exception of transit of surface vessels and actions required for the protection of "life, property or the environment," no activity can be undertaken in the sanctuary without the prior written approval of NOAA. Expressly prohibited are anchoring, diving and salvaging operations, drilling, detonation of explosives, laying of cables, trawling, deployment of over-the-side equipment, and the discharge of waste materials. According to newly formulated regulations, research activities in the sanctuary required a written permit from NOAA (Federal Regulations 924, 1975). As research and recovery proposals were being studied, formulation of a system for reviewing the merits of proposals for work at the site and the development of guidelines for research activities became another of NOAA's initial management priorities.

In conjunction with the Underwater Archaeology Branch of the North Carolina Division of Archives and History, the staff of NOAA's Office of Coastal Zone Management formulated a system for reviewing proposals to conduct investigations at the site. Research permit applications were required to contain sufficient information to permit an evaluation of:

> ...such matters as (1) the general professional and financial responsibility of the applicant; (2) the appropriateness of the research method(s) envisioned to the purpose(s) of the research; (3) the extent to which the conduct of any permitted activity may diminish the value of Monitor as a source of historic, cultural, aesthetic, and or maritime information; (4) the end value of the research envisioned; and (5) such other matters as...appropriate (NOAA 1983).

In light of the multidisciplinary and complex nature of the anticipated research, both agencies agreed that decisions to approve or deny permits should be granted with the advice and recommendations of recognized authorities in fields related to investigation of the Monitor.

To maximize output into the decision-making process developed by NOAA and the North Carolina Division of Archives and History, each research proposal would be evaluated by members of two separate review committees. The first, designated the Technical Advisory Committee, was to be composed of authorities in such disciplines as underwater archaeology, naval and maritime history, conservation, engineering, oceanography, geology, and museology. It would be their responsibility to comment and make recommendations concerning the technical aspects of proposed research. A second advisory council, designated the Governmental Review Committee, would be composed of representatives from agencies and institutions having expertise or authority in such fields as historic preservation, history, archaeology, and museology. Members from participating agencies such as the Smithsonian Institution, National Trust for Historic Preservation, and the United States Navy would also review proposals and evaluate the impact of proposed research on long-term goals for developing the remains of the *Monitor*. With recommendations from both advisory councils, NOAA would render a decision to approve, recommend revision, or deny each application (NOAA 1983).

Once the advisory committee's criteria for research proposals and the review process had been established, attention was focused on the formulation of guidelines for research to ensure that the most desirable long-term options for development of the *Monitor* were not compromised. In response to the need for guidelines set forth in a series of meetings called to discuss the *Monitor's* future, the North Carolina Division of Archives and History agreed to coordinate the preparation of a master planning document for the *Monitor* National Marine Sanctuary (National Trust 1978). Having been delegated responsibility for the development of the master planning document, the Underwater Archaeology Branch served as a nucleus in consolidating and refining input from Federal, state, and local agencies, institutions, foundations, museums, and an extensive group of archaeologists, naval and maritime historians, engineers, museologists, oceanographers, and conservators. By March 1979, the document had been refined to identify basic research goals and developmental options (Sanctuary Concept mss).

A research philosophy committed to two primary goals was adopted. The first goal was to ensure the scientific recovery and dissemination of the historical and cultural information preserved at the wreck site. The second and equally important goal was the preservation and development of the remains of the *Monitor* in a manner that appropriately enhanced the historical significance as well as the scientific and educational potential of the warship. To accomplish these goals, the planning document included a four-

phased proposal designed to identify the most appropriate and feasible research and development options and to identify data essential for making responsible decisions concerning these options. Once amended to include revisions suggested in a national conference sponsored by the Smithsonian Institution on October 23, 1978, the *Monitor* Marine Sanctuary Research and Development Concept was approved and recommended to NOAA by the Technical Advisory Committee on March 5, 1979 (NOAA, 1983).

Subsequent On-Site Research

Following the *Alcoa Seaprobe* cruise a series of limited investigations were carried out at the Monitor site with support from a variety of institutions. The first of these was conducted by Duke University and the University of Delaware in May 1974 shortly after the *Seaprobe* departed. Carried out from the R/V *Eastward*, the operation consisted of random dredge sampling in the vicinity of the wreck to recover artifacts associated with the ship. No analysis of the recovered material was developed although the collection included historically interesting material such as a decklight cover and other small concreted artifacts.

Later in August of 1974, the United States Coast Guard and the Massachusetts Institute of Technology cooperated to test a remote-controlled search and investigation pod. Operating from the cutter *Chilula* , a camera pod designated "Snoopy," was deployed to examine wrecks at several sites off Cape Hatteras including the *Monitor*. Equipped with sonar, closed circuit television, and 35 mm cameras, Snoopy was to be utilized to document the wreck and recover samples of material. Heavy seas complicated operation of the system, and no contact with the *Monitor* was confirmed.

With funding provided by the National Science Foundation and the University of Delaware, the recently organized *Monitor* Research and Recovery Foundation carried out a two-day investigation in the USS *Monitor* National Marine Sanctuary in June 1976. Using a proton precession magnetometer, investigators collected data to establish the Monitor's effect on the surrounding regional magnetic field during eight crossings of the wreck. At the same time a subbottom profiler was employed to establish the general direction of the slope of subbottom reflectors in the area and the location of the wreck relative to these reflectors (Sheridan 1977). The following year the *Monitor* Research and Recovery Foundation and the University of Delaware carried out a second project at the site. With support from the Exxon Educational Foundation, the project was designed to collect environmental data and document the wreck using closed circuit television. A horizontally configured underwater television camera permitted the first oblique examination of the wreck site. However, the most important data was produced by a current meter and piston core of the bottom sediment in the vicinity of the wreck site.

In 1977, the National Oceanic and Atmospheric Administration, the North Carolina Department of Cultural Resources, and Harbor Branch Foundation joined in the first attempt to conduct on-site investigation of the historic shipwreck. The investigation employed the highly sophisticated research submersibles and surface support vessels of Harbor Branch Foundation (Figure 3) to conduct a photogrammetric survey of the wreck and recover selected materials for testing and analysis. The project provided the first opportunity for investigators to visit the site and employ lockout divers in the conduct of research activities (NOAA, 1977).

After a side scan sonar examination of the bottom inside the sanctuary, a Cabled Observation and Rescue Device (CORD), a remote controlled vehicle, was utilized to conduct a closed circuit television examination of the wreck. With the site and potential hazards identified, on-site manned submersible operations were initiated. Following a series of dives to examine the wreck and familiarize submersible pilots, divers were locked out along the port armor belt to deploy a baseline designed to control photogrammetric data collection. After the baseline had been deployed approximately 10 feet north and roughly parallel to the armor belt, three sets of photographic passes were made diagonally across the wreck. On two of the operations, black and white film was used to document the *Monitor* while the third sequence was photographed in color.

Once the stereo photography had been completed, divers were locked out to recover the remains of an oceanographic camera lost during the original R/V *Eastward* investigation, a sample plate from the lower hull, and a brass lantern identified on the first manned submersible operation in the sanctuary. Preservation of the lantern and testing, analysis, and preservation of the sample hull plate provided the first hard evidence of the physical condition of the *Monitor* and the complex nature of preservation problems associated with the recovery of additional material from the site. Photographic records and visual observations made from the *Johnson-Sea-Link* submersibles provided insight into the nature and condition of the wreck that was not possible with previously employed remote observation equipment (Childress et. al. 1978).

Although camera problems frustrated development of a three dimensional plan of the wreck site, the investigation provided new insight into the condition of vessel remains at the site. A brass navigation lantern and an iron hull plate recovered by divers working under the supervision of project archaeologists provided the first physical evidence. Following a Naval Research Laboratory sponsored meeting to determine the most appropriate use of the plate sample, laboratories were selected to conduct a variety of structural and non-destructive tests. With the assistance of United Technologies Research in East Hartford, Connecticut, a carbon dioxide laser was used to cut samples from the hull plate. These were distributed to the Naval Research Laboratory, Massachusetts Institute of Technology, and the University of Delaware for research. The remaining portion of the plate was shipped to the Institute of Nautical Archaeology at Texas A&M University for conservation. Analysis of the plate confirmed the advanced nature of structural deterioration (Hill 1981).

In 1979, two expeditions were carried out in the USS *Monitor* National Marine Sanctuary. The first of these was a limited photographic project supported and carried out by the Cousteau Society, Inc. Operating from the R/V *Calypso* and working in groups of up to eight, divers using compressed air made four visits to the site. The first of these was a reconnaissance dive. During the second dive, approximately 12 minutes of film were exposed. The second attempt to film was unsuccessful because of currents that prevented divers from locating the wreck, and the fourth dive was made to clear the area of buoys deployed to support the operation (Watts 1981).

The second investigation was carried out in August 1979 and proved to be the most extensive and complex research previously undertaken in the USS *Monitor* National Marine Sanctuary. The month-long investigation was jointly sponsored by the National Oceanic and Atmospheric Administration, the North Carolina Division of Archives and History, and Harbor Branch Foundation. It was designed to utilize the sophisticated submersible diver delivery and support submersibles of Harbor Branch to accomplish five major objectives: (1) establishment of a series of permanent provenience stations; (2) conduct of a limited test excavation; (3) photographic and video tape documentation of vessel remains at the site; (4) vessel structure attitude analysis; and (5) a limited amount of structural testing (NOAA 1979). Secondary objectives included the recovery of samples to facilitate defining conservation requirements for ma-

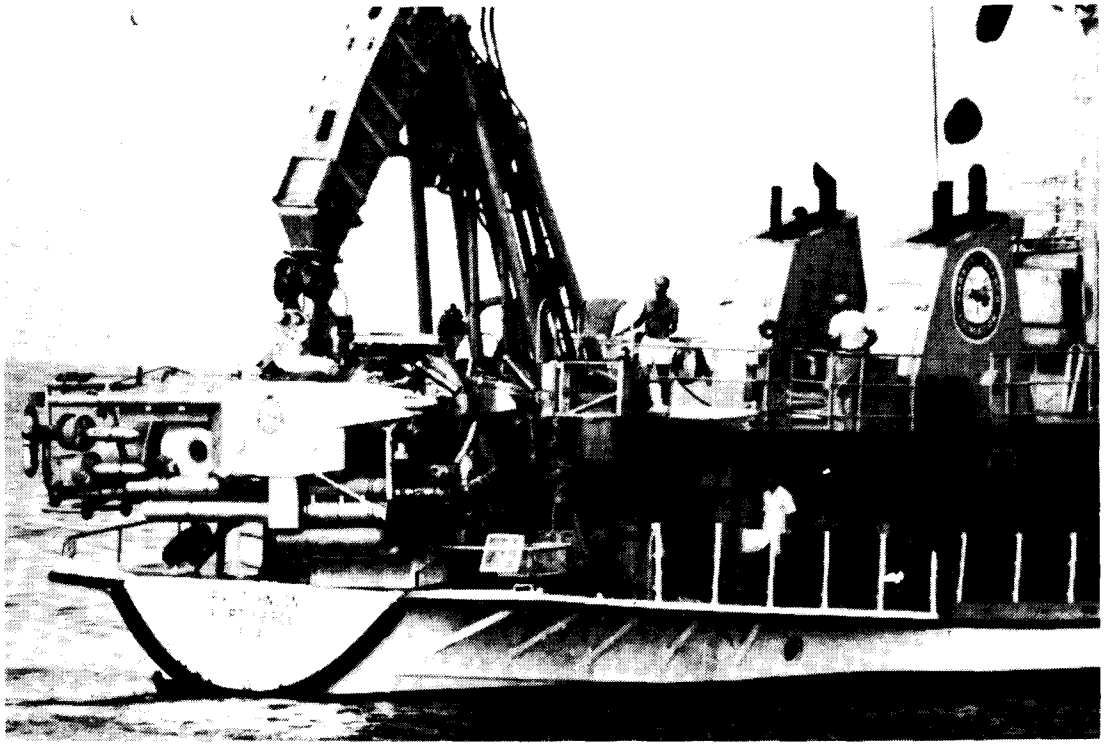


FIGURE 3. *Johnson-Sea-Link* submersible aboard the R/V *Johnson*

terial recovered from the site, expanded photographic and video tape documentation, and the installation of additional provenience stations. Each of these objectives was designed to generate archaeological, conservation, and engineering data essential to the development of responsible management policies for the *Monitor* National Marine Sanctuary and all were identified during the preparation of the "*Monitor* Marine Sanctuary Research and Development Concept" (NOAA 1978). For underwater archaeologists it would provide a rare opportunity to employ Harbor Branch Foundation's highly sophisticated submersibles to support an extended mixed gas lockout excavation at 225 feet (NOAA 1979).

Perhaps the most critical priority for continued investigation at the site was the establishment of a permanent system of references to control on-site data collection. To provide the desired control a master system composed of ten permanent provenience stations was designed to encompass the major concentration of hull remains with a 200-foot by 68-foot rectangle. Located outside the confines of the hull, the reference stations would provide accurate and accessible dimensional reference both inside the wreck and anywhere in the immediate environment. At the initiation of on-site work, the nucleus of this baseline system, composed of four noncorrosive 3-inch diameter, 10-foot sections of schedule 80 polyvinyl chloride (PVC) pipe, was jetted into the sediment along the north side of the wreck adjacent to the armor belt (Figure 4).

Once a series of on-site datum stations had been established an aluminum grid was erected over a preselected test site. A 5-foot-by-5-foot excavation was carried out within the confines of the hull immediately inboard of the port armor belt in the vicinity of the captain's lounge. The test excavation was designed to generate data concerning specific questions about the nature and extent of the archaeological record preserved at the site, the evaluation of acceptable methods and techniques that could be employed in the recovery of that record, and recovery of artifacts for analysis and conservation (Watts 1981).

The excavation process consisted of a highly regimented sequence including mapping and photography, excavation, additional mapping and documentation, artifact recovery, and additional excavation. As the small dredge removed each successive level of sediment, additional insight into the archaeological record was developed. The disposition of artifacts within the excavation confirmed that the ironclad had rolled over on sinking and gone down by the stern. The archaeological record also confirmed that the hull had survived intact for a considerable period prior to a catastrophic collapse. The stratigraphic record supported the hypothesis that the shipwreck may have been depth charged during World War II. Artifacts from the ship confirmed both an excellent state of preservation and the complex nature of the record of life aboard the Cheesebox-on-a-Raft (Watts 1981).

Ordinarily a labor-intensive activity, excavation inside the *Monitor* was carried out by archaeologists operating alone for a maximum of two 1-hour periods each day. Each individual was required to work quickly and effectively to complete the excavation. In addition to severe constraints on each archaeologist's time, all equipment used on-site had to be safe and functional at 225 feet, capable of being delivered and, if necessary, also powered by the *Johnson-Sea-Link* submersible.

With assistance of engineers from Harbor Branch and the Physics Laboratory at North Carolina State University each problem was

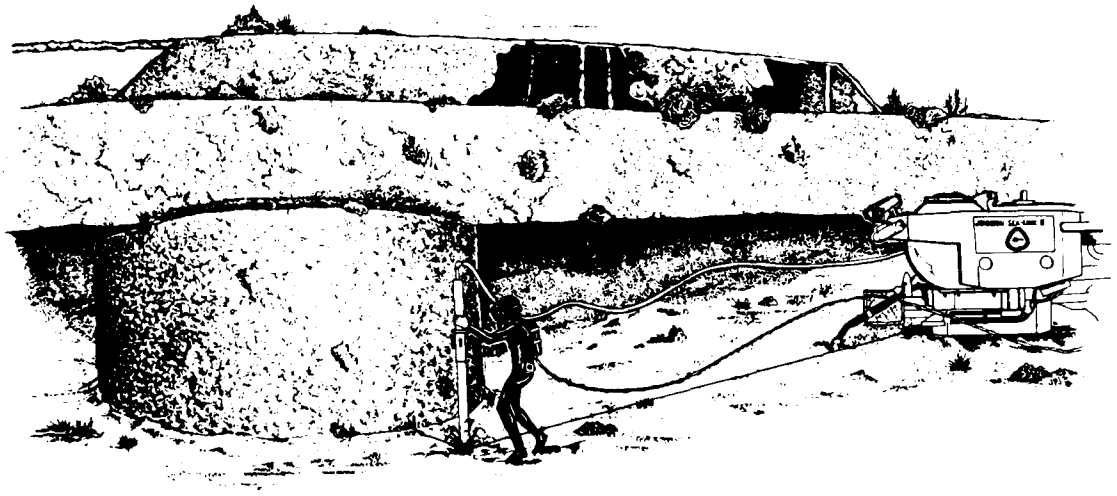


FIGURE 4. Artist rendering of datum casing placement.

solved. To permit excavation to proceed with dispatch without compromising record keeping, closed-circuit television was used to record excavation activity. Notes and observations were recorded on the acoustic record with assistance from a helium unscrambler. Traditional notes would be taken only when absolutely essential. A light-weight aluminum excavation frame was designed to support a 35 mm camera system to permit stereoscopic photo-mapping of material exposed in-situ. Elevation within the excavation was controlled by a bubble level especially fitted with an electronic indicator to permit operation by a single diver. Excavated material was removed from the hull by a hydraulic dredge powered by a centrifugal pump operated by one of the submersible's thruster motors.

Within the excavation carried to the deck above Captain Bankhead's lounge, attention was turned to investigating the interior of the historic ship. With closed circuit television and 35 mm cameras a record of the condition of the wreck was compiled. Forward of an amidships bulkhead the lower hull had collapsed, exposing the quarters of the officers and crew. There structural damage was extensive but a variety of fragile artifacts were found intact. Amid shoes, crockery, and weapons that surrounded one of two ruptures in the *Monitor's* deck an intact storage jar was recovered. The contents, clearly identifiable as relish, were preserved by a patented rubber seal. In a store room located inboard of the port armor belt and immediately forward of the amidships bulkhead a number of additional glass vessels containing pepper and mustard were located and recovered (Watts 1979).

Aft of the amidships bulkhead the engineering space was found to survive virtually intact and protected by the remains of the lower hull. Here, perhaps due to the additional strength required to support the ship's machinery, the vessel had not collapsed. Although brightly colored fouling organisms covered every exposed surface, details of the galley and engine room proved readily identifiable. In the galley *Monitor's* cast iron stove had collapsed after falling to the deck as the ship rolled over on sinking. Close by, near the port armor belt lay the remains of a large centrifugal pump, perhaps the high capacity Adams pump installed to provide every assurance that the bilges could be kept clear of water even under the most adverse circumstances. The Martin boilers, although separated from their beds, rested on deckbeams near their original locations. Ten feet aft of the boilers the complex and imposing structure of the vibrating level engine designed by Ericsson was identified. Starboard and port of the unique engine were the blowers that provided forced draft ventilation of the boilers. A closer examination of the port blower confirmed historical records which indicated that heavy leather belts used to drive the blowers had become water soaked and slipped off their pulleys. With the exception of a sample of coal recovered from a deteriorated port bunker nothing in the engineering space was disturbed (Watts 1986).

Prior to completing the reconnaissance investigation of the ironclad several lockout operations were designated for examination of the turret structure. In addition to documenting the exterior, plans called for identification of potential avenues of access to the interior. Because the hull of the ship came to rest on the turret, the examination required work under the deteriorating hull. As some of the large armor plates covering the vessel's wood deck proved to be loose this work was kept to a minimum. Once the gunports had been examined, found closed, and photographed, an attempt was made to locate access hatches in the bottom of the structure. Probing the wooden base of the turret with a high pressure gas probe confirmed that the wood was intact but that the cellular structure had deteriorated. With the exception of a small hole for the shaft upon which the turret rotated, no indication of available access could be identified. (Examination of the interior of the turret would have to wait for a future investigation.) (Watts 1979)

Finally, at preselected locations along the armor belt and lower hull, inclinometer measurements were made to determine the degree of list and pitch of the hull remains. These measurements were analyzed to determine the degree of stress-related distortion and to calculate the amount of accumulated sediment inside the hull. An inclinometer specifically designed for the project was employed to produce the desired data.

Research at the site carried out in 1977 and 1979 and a series of engineering studies of the wreck structure confirmed that the combined forces of stress and deterioration threatened the remaining structural integrity of the wreck. Collapse of the remaining hull structure would have an adverse impact on the resource. In considering these factors, the Technical Advisory Committee formed by the

North Carolina Division of Archives and History to assist the National Oceanic and Atmospheric Administration in evaluating proposals for research in the *Monitor* National Marine Sanctuary recommended that recovery, conservation, and display of the wreck be adopted as a major goal in the USS *Monitor* National Marine Sanctuary Management Plan. Those recommendations were prepared in the form of a resolution and adopted on November 9, 1982, in Raleigh, North Carolina.

In an effort to generate additional data concerning deterioration and stress at the wreck site and collect data essential to the development and assessment of plans for the recovery, conservation, and display of the USS *Monitor*, NOAA, East Carolina University, and Harbor Branch Foundation agreed to sponsor a cooperative expedition to the site in August 1983. Plans for the investigation included a variety of archaeological, engineering, and documentary objectives. The research was designed to represent the first phase of a four-phase investigation designed to generate all of the additional archaeological, historical, technological, conservation, and fiscal data determined to be essential for formulating and evaluating plans for the in-situ stabilization of the *Monitor's* remains and recovery of as much of the ship as determined to be technologically and fiscally feasible (NOAA, 1983).

Objectives for the first stage of the proposed research included six primary tasks. The first of these was to generate additional documentary evidence of both the shipwreck structure and on-site activities. A new broadcast-quality color video system on the *Johnson-Sea-Link* submersible would permit high-quality color records to be made of the wreck. This was identified as a primary objective as previously generated video tape records had provided an invaluable reference for archaeologists, engineers, historians, and others interested in studying the *Monitor's* remains. The second objective was to establish the nature of the present turret-armor belt relationship. Along with the third objective, defining the nature of sediments supporting the wreck structure, this relationship was identified as a critical element in developing plans for stabilization of the wreckage. Sampling and testing of the wreck structure were adopted as the remaining objectives. Material from the vessel would provide much needed insight into the integrity and strength of the *Monitor's* remains and permit additional testing and conservation experience with material from the site (NOAA 1983).

Although poor visibility and deteriorating weather prevented accomplishing work associated with the primary objectives, the *Monitor's* distinctive anchor was located using the *Johnson-Sea-Link's* sophisticated sonar. Previously identified as a target for recovery, the anchor was documented and, with some difficulty, brought to the surface. After transportation to temporary preservation facilities at East Carolina University the anchor was cleaned, stabilized, and turned over to the NOAA for exhibit (Figure 5).

Results of a Decade of Research

Data generated by ten years of research in the *Monitor* National Marine Sanctuary has supported a variety of conclusions. Whether related to the nature and scope of the archaeological record preserved at the site, condition of the vessel remains, the environment, or the complications involved in the conduct of research at the site, these conclusions focused additional light on the questions posed by future research and development. While data generated by these investigations does not provide sufficient information to support the formulation of definitive plans for the site, it has greatly expanded our knowledge of the *Monitor* and certainly set the stage for the collection of data that will permit realistic and viable options to be determined.

Archaeology

Both testing and exploration of the remains of the Monitor confirmed that the shipwreck contains a rich and varied collection of material associated with the vessel. The broad spectrum of material represented in the limited number of artifacts recovered during investigations of the wreck have included wood, leather, rubber-impregnated fabric, glass, ceramics, iron, brass, and provisions. Several fragile, yet intact vessels of glass indicate that a considerable amount of similar material may have survived both the destruction related to the sinking and subsequent natural and/or man-made deterioration at the site. The presence of a substantial accumulation of light sediment in the lower level of the test excavation indicated that excellent possibilities for the preservation of fragile organic material exist. The potential for preservation, perhaps characterized by recovered samples of relish, pepper, leather, and wood, is enhanced by cool water temperatures recorded at the site (Watts 1986).

While deterioration of the lower hull has contributed to the preservation of material associated with the ship, damage to the upper hull has permitted some redistribution and disturbance of original provenience. In the wardroom, magazine, and after-engineering compartment, ruptures in the structure provided unobstructed access to the seabed below the wreck. Currents flowing across the wreck created a venturi effect at these locations and doubtlessly contributed to distribution of material outside the confines of the hull remains. The observed presence of material from the interior of the vessel adjacent to the port armor belt in the vicinity of both the wardroom and magazine and the recovery of several bottles and a brass lantern base in the vicinity of the baseline confirmed the redistribution of this material (Watts 1986).

With the exception of disturbed material in those areas of natural and perhaps man-made damage, artifacts within the remainder of the hull can be expected to be segregated by bulkheads that divided the ship into compartments. Structural evidence exposed by the test excavation and observed in investigating the wreck indicated that both structural and nonstructural bulkheads survived the sinking to maintain the segregation of material established during the ship's operations. This segregation should provide excellent contextural information and historical association.

In examining the sediments exposed by the 1979 test excavation, it was obvious that the upper stratum has been extremely active in recent time. The high energy of this sand and shell hash material was observed during the project and confirmed by the presence of a modern plastic garbage bag and two other pieces of modern plastic at depths of up to 14 inches. On one occassion in 1979, while the R/V *Johnson* was on a three day trip to Beaufort, North Carolina to take on additional fuel and diving gas, more than a foot of overburden was found to have accumulated in the test excavation. While this must be confirmed by additional test excavation in other areas inside and outside the wreck, the evidence indicated that a substantial amount of sediment could be arbitrarily moved without compromising the archaeological integrity of the site. Should the option to recover the *Monitor* be exercised, removal of this sediment could greatly reduce the dead lift weight of the vessel remains (Watts 1979). In the test excavation this upper stratum and that which sealed the sediment containing material associated with the *Monitor* were clearly discernible.

While the material inside the confines of the hull should be removed in accordance with the strictest archaeological controls, that distributed outside the confines of the hull should require only two dimensional provenience. This should be more than sufficient to establish an association with the wreck that has been extensively disturbed by natural or perhaps man-made processes. Material

FIGURE 5. Anchor conservation.

located under the wreck should be treated in a similar manner without the loss of significant data.

Engineering

Perhaps the most significant engineering data generated by on-site activities resulted from observation made during submersible and diver exploration of the wreck. Photographic records of the interior and underside of the vessel considerably enhanced our understanding of the condition of the wreck and provided heretofore unavailable insight into the condition of the *Monitor's* remains. Several observations relate directly to the questions critical to the formulation of realistic recovery plans (NOAA 1979; Watts 1986).

All observations pertaining to the present condition of the *Monitor* confirmed that recovery plans must be based on the hypothesis that vessel remains at the site have very little overall structural integrity. With the possible exception of the turret, no part of the Monitor can be assumed to have retained sufficient strength to support itself under the additional stresses imposed by recovery. The construction of a litter capable of supporting the remains of the ship or an alternative that would provide complete support for the remaining structure will be essential (Watts 1981; Muga 1981).

Examination of exposed wood and iron confirmed the fragile condition of the wreck. Investigation of the condition of the wood backing for the armor belt, the wood floor of the turret, and exposed deck beams confirmed that teredo and pholad damage has been extensive. Wood samples recovered from the test excavation indicated that cellular deterioration has been extensive although, as might be expected, wood protected by sediment accumulation has retained some strength (Watts 1981).

Examination of the iron armor and lower hull plating confirmed that the interface between plates and fastenings had deteriorated through electrochemical galvanic action. While individual plates and fastenings retained some of their original strength, the bonding

surfaces have deteriorated to compromise the structure itself. While this deterioration will probably prove to be significantly less where the wreck has been protected by the accumulation of sediment, areas exposed to the water column have deteriorated extensively. Sagging 1-inch armor plate attached to the wood deck beams and planking confirmed this deterioration (Watts 1986).

Inclinometer studies provided a preliminary indication of the amount of distortion in the hull remains. Ruptures in the deck in the vicinity of the wardroom, magazine and after-engineering space confirmed the extent of this damage and the deterioration that has occurred. Buckling plates on the bottom of the port armor belt immediately forward of the turret suggested that this structure has also been affected by both deterioration and considerable pressure.

Examination under the vessel indicated that perhaps one-half of the wreck was supported above the surface of the bottom. Should recovery be attempted, this space would provide important working access for the construction of a litter. While the two forward casings could not be washed into the sediment because of a consolidated layer of shell hash or material from the wreck, sediment under the wreck should prove to be no obstacle to recovery-related construction.

Conservation

To date the conservation of cultural material associated with the remains of the *Monitor* has included leather, rubberized fabric, ferrous and nonferrous metals, wood, glass, and ceramics. While these have presented no insurmountable conservation problems, the remains of the *Monitor* will no doubt be another matter entirely. Examination of the condition of the wreckage indicated that the cost of traditional conservation involved in the stabilization of the vessel remains would be staggering. Because of the composite nature of construction, the vessel would have to be disassembled, organic portions of the structure preserved in one way, and the inorganic portions of the structure preserved in another. Once each part of the vessel had been cleaned and preserved, the pieces would have to be reassembled in conjunction with a structure capable of supporting the weight of surviving iron. Such a structure would also have to be capable of securing in position numerous portions of the vessel too far deteriorated to be reassembled. Compared to the complexity and expense or recovery, that of conservation, stabilization, and restoration would be far more expensive (Watts 1986).

Operations

In examining the problem of conducting even limited archaeological investigations at depths requiring sophisticated breathing gasses and delivery systems, it is obvious that saturation-mode operations represent a distinct advantage. Every hour of on-site diving activity required approximately 4 1/2 hours of decompression on the chamber aboard the support ship. This schedule automatically limited daily on-site operations to a minimum of two hours. While the lengthy decompression schedule provided an abundance of time for evaluating and assessing each dive, the schedule became extremely taxing mentally and physically after the first two weeks (Watts 1986). A saturation system would greatly increase the amount of on-site time and would permit a more concentrated scheduling of activities.

Working in water temperatures ranging from 18 to 26 degrees Celsius (64.4 to 78.8 degrees F) in conventional wetsuits made an endurance contest out of a number of the lockouts. With compression significantly reducing thermal properties of the wetsuits and the chilling effects of a cold breathing gas mixture added to the water temperature, archaeological priorities deteriorated rapidly toward the end of each lockout. Working slowly and meticulously in the 1979 test excavation also seemed to accelerate the effects of the cold. Toward the end of the excavation it was noted that the lockout times could be extended by utilizing the last half of each dive for exploration of the wreck. Exertion associated with vigorous movement appeared to generate some reserve body heat (Watts 1981).

Communications, always a problem at depth, were additionally complicated by breathing a mixture of helium and oxygen. In spite of the helium unscrambler, extensive communications proved impossible, eliminating the possibility of recording observations verbally. While some voices could be understood with regularity, others proved quite impossible and defied translation by the diver himself.

While the submersible delivery and support system provided adequate support for the limited objectives of a test excavation, extensive work at depth will require a different type of diving system. Additional power for tools would have to be available before extensive excavations could be carried out with efficiency. Complicated tasks could have been accomplished faster and with a higher degree of accuracy had more than one investigator been able to lock out at the same time.

Recommendations for Future Investigation

Prior to the development of plans for further investigation in the *Monitor* National Marine Sanctuary, additional engineering and historical research tasks should be addressed. Both have a critical bearing on the development and assessment of options for future investigation and development of the *Monitor*. As on-site time is limited, every operation should be designed to maximize the variety and amount of data collected.

Before planning another extensive project at the site, a comprehensive engineering analysis of recovery feasibility should be carried out based on both historical and on-site research data. The project should be designed to analyze all extant data in light of a minimum of three options: 1) recovery of the entire vessel intact; 2) recovery of the entire vessel in sections; and 3) recovery of the turret without damaging the remains of the hull. In every case, planning must be based on the premise that remains of the *Monitor* no longer have structural integrity to support themselves under the additional stress of recovery operations. This study should also identify any additional information from the site that is required before decisions regarding recovery operations can be made and should spell out methods of collecting that data. Recovery operations should carry the project through the transportation of the remains of the *Monitor* to a safe harbor and address the deposition of the shipwreck, its part, or the turret in a container or containers suitable for long-term storage and stabilization (Watts 1981).

Prerequisites to the effective planning and development of engineering studies designed to address options for development of the site is a program of historical research designed to identify extant engineering data contemporary with the construction and refitting of the *Monitor*. While much of this is underway, it should be expanded to locate and analyze any primary source material associated with the refitting of the vessel in Washington Navy Yard in 1862. All available data should be converted into a series of engineering drawings that can be used in the formulation of plans for future investigation and the development of engineering feasibility studies for the recovery of the remains of the *Monitor*. Compilation of these drawings will isolate aspects of the vessel's design and construction that can only be identified through research at the site and define those on-site observations required to collect that information (Watts 1981).

In light of the complexities, expense, and final results of conventional conservation and stabilization of the *Monitor*, it might be worthwhile to assume that the most feasible postrecovery options for storage and display would be to maintain the wreck in its present condition in an environment similar to that of the *Monitor* National Marine Sanctuary. This would eliminate the majority of the tremendous cost of disassembly, cleaning, conservation, reassembly, and long-term curation associated with conventional conservation yet not preclude that possibility at some future date. Appropriately maintained as it exists today, the wreck would provide an excellent exhibit, deterioration could be retarded or arrested by electrochemical methods, research on the wreck could continue to generate data about the ship and crew, and objects from the wreckage could be removed as necessary for research, preservation, and interpretive exhibits.

From an archaeological perspective the next phase of on-site operations should be designed to continue site documentation and testing. Test excavations should be carried out outside the confines of the hull on both the north and south sides of the wreckage. On the north side the excavation should be located adjacent to the turret and immediately forward of the amidships bulkhead. Each of the test excavations proposed for areas outside the confines of the hull remains should be designed to document the distribution of material associated with the wreck in a sediment profile (Watts 1986).

Inside the hull of the ship additional testing should be carried out inboard of the starboard armor belt immediately forward of the amidships bulkhead and in the engineering space inboard of the starboard armor belt between the boilers and blowers. A final test excavation should be conducted immediately forward of the ruptures in the deck above the magazine. Excavations outside the hull confines should be limited to 10-foot-by-10-foot squares and those inside the confines of the hull to 5-foot-by-5-foot squares unless the delivery and support systems provide more on-site diver time and mechanical assistance than were available in 1979 (Watts 1986).

Additional research at the site should also be designed to complete placement of the series of datum casings so that additional research can be readily tied to a master reference grid. Once this has been established, a series of profiles of the wreck should be made to determine accurately the degree of list, pitch, and distortion. These profiles would also serve as a frame of reference for establishing a three-dimensional plan of the wreck using photogrammetric data collected in 1977.

Future work at the site should be designed to permit an investigation into the turret. Data concerning the interior of the structure will be essential to planning and assessment of recovery options and provide answers to myriad historical, engineering, and archaeological questions. Perhaps in conjunction with this investigation a thorough and systematic closed-circuit and photographic study of the wreckage could be accomplished (Watts 1982). Information from both of these projects would be invaluable regardless of the orientation of future options and could be effectively utilized in developing educational programs and exhibits.

In light of the tremendous interest in research and development of the *Monitor* considerable emphasis should be placed on the development of displays and exhibits to convey to the public the significance of the ship, nature of research in the *Monitor* Marine Sanctuary, and options for development of the site as a resource of national significance. Although the ship may never be raised, films and publications can be designed to compensate for the inaccessibility of the site.

Before permitting any operations in the *Monitor* Marine Sanctuary that are designed to recover material from the ship or portions of the vessel itself, a comprehensive plan, staff, and facilities for conservation should be available. If facilities and funding for the punctual cleaning, conservation, and storage or material from the site cannot be assured prior to proposed operations, no project to recover material should be permitted. Today, with the exception of laboratories in Texas, Florida, New York, South Carolina, and Maine, adequate facilities do not exist. Finally, an effort should be made to increase the effectiveness of surveillance in the *Monitor* Marine Sanctuary. The Cousteau operation in May 1979 certainly illustrates the accessibility of the site for anyone with moderately sophisticated equipment. Although diving from the surface with conventional sport diving equipment represents a tremendous risk, the *Monitor* and the material that the site contains is of sufficient value to make the illegal operation attractive (Watts 1981 and 1982).

Data from a decade of investigation of the *Monitor* has provided concrete insight into both the condition of the wreck and the nature and scope of the archaeological record preserved at the site. It is clear that investigation of the ship would generate new and exciting information concerning the design and construction of the *Monitor* and the lives of those who served the historic ship. Observations about the wreck also confirm that, unlike the remains of vessels completely submerged in bottom sediments, the wreck structure was deteriorating in a high energy water column environment. Unless measures are taken to relieve the stress created by the position of the turret, intact portions of the ship structure will no doubt collapse resulting in the loss of valuable historical and archaeological data. As the USS *Monitor* represents one of our most valuable historic resources we must make a concerted effort to preserve and develop this important aspect of our national heritage.

REFERENCES

BRENNAN, WILLIAM J.
1975 *An Historic Ship Launches an Important Marine Program. NOAA* (April)

CHILDRESS, FLOYD
1977 *The Lantern.*, NOAA October, pp 7-9

CHILDRESS, FLOYD; Watts, Gordon P., Jr., Roger W. and Chester C., Slama
1977 *Preliminary Report, Stereo Photography and Artifact Retrieval, 16 July - 2 August 1977*, Office of Costal Zone Management, NOAA

D'ANGELO, SCHOEWALT AND ASSOCIATES.
1981 *Preliminary Recovery Feasibility Study*, North Carolina Division of Archives and History, Raleigh, NC.

FOGLER, R. H.
1953 *Recommendation for Abandonment of* U.S.S. *Monitor.*, Official Correspondence of the Secretary of the Navy

GENEVA CONVENTION ON THE CONTINENTAL SHELF, Article II, UST 471 T.I.A.S. No. 5578; 1978

HILL, DINA B., ED.
1981 *Hull Plate Sample Analysis and Preservation.*, U.S.S. Monitor Technical Report Series, U.S. Office of Coastal Zone Management, NOAA, April

KRONMILLER, THEODORE G.
1982 *Statement of Deputy Assistant Secretary of Oceans and Fisheries Affairs*, before the Subcommittee on Oceanography of the House Merchant Marine and Fisheries Act, July 15, 1982

MANAGEMENT PLAN, U.S.S. MONITOR NATIONAL MARINE SANCTUARY,
1983 U.S. Dept. of Commerce, NOAA, February

MARINE PROTECTION RESEARCH AND SANCTUARIES ACT OF 1972
1972 Title III, PL 92-532, 16 USC pp-1431-1434 U.S. Department of Commerce, NOAA

MONITOR
n.d. *Marine Sancutary Research and Development Concept*, an unpublished manuscript on file at East Carolina University, Greenville, NC

MUGA, BRUCE
1981 *Engineering investigation of the* U.S.S. *Monitor*, 1978, Department of Commerce, NOAA

NATIONAL TRUST FOR HISTORIC PRESERVATION IN THE UNITED STATES
1978 *The Monitor: it's meaning and future.* Papers from a national conference, April 2-4, 1978

NEWTON, JOHN G. and WATTS, GORDON, P., JR.
1979 The Role of Archival Records in the Location and Indentification of the *Monitor., Proceedings of the National Archives Conference on Naval History,* National Archives, Washington, DC

NOAA OPERATIONS MANUAL
1979 *Monitor Marine Sanctuary, an Archaeoloical and Engineering Assessement,* Department of Commerce, NOAA

NOAA MONITOR MARINE SANCTUARY
n.d. Final regulations, 15 CRF , Department of Commerce, NOAA

SHERIDAN, ROBERT E.
1977 Recovery of the *U.S.S.Monitor, University of Delaware News,* Winter, p. 240

TUCKER, ROCKWELL G.
1981 *Environmental Data* , North Carolina Division of Archives and History, Raleigh, NC

U.S. GOVERNMENT CODE OF FEDERAL REGULATIONS
n.d. 15 CRF 924, Department of Commerce, NOAA

U.S.S. MONITOR NATIONAL MARINE SANCTUARIES MANAGEMENT PLAN
1983 NOAA, Department of Commerce, NOAA

WATTS, GORDON, P., JR.
1975 The Location and Identification of the Ironclad U.S.S. *Monitor, International Jounral of Nautical Archaeology,* vol. 4

1975 *Monitor of a New Iron Age: the Construction of the* U.S.S. *Monitor,* M.A. Thesis, East Carolina Unversity, Greenville, NC

1982 *Investigating the Remains of the* U.S.S *Monitor*: a final report of 1979 site testing in the Monitor National Marine Sanctuary., N.C. Division of Archives and History, Raleigh, NC

1985 Deepwater Archaeological Investigation and Site Testing in the Monitor National Marine Sanctuary, *Journal of Field Archaeology*, Vol. 12.

GORDON P. WATTS, JR.
PROGRAM IN MARITIME HISTORY AND UNDERWATER RESEARCH
EAST CAROLINA UNIVERSITY
GREENVILLE, NORTH CAROLINA

CURTISS E. PETERSON

CONSERVING THE *MONITOR*

In spite of their comparatively short history as a people, Americans have accumulated a number of national icons. As one of four sacred vessels in American history, the *Monitor* is numbered among them.

Of the several armed conflicts the United States has been party to, a few have made much more profound impressions on the nation than have the rest. If in these conflicts naval vessels have distinguished themselves honorably and notably, certain of these vessels become part of the national myth symbolizing the conflict, its victories and its sacrifices. I suggest that the United States has produced four such vessels. The three vessels that I feel share this category with the *Monitor* are:

The *Bonne Homme Richard* commanded by John Paul Jones, that restored our national maritime pride during the American Revolution.

The *Constitution*, Old Ironsides, of the war of 1812 that has come to symbolize our defence of the country in the first military test of the new nation and, which has certainly augmented her status, the *Constitution* is still afloat and in commission, having been preserved by methods that were a bit controversial at times, but preserved nonetheless. Visibility is an important aspect of icon status.

The *Arizona*, sunk during the Japanese attack on Pearl Harbor has become the symbol of the effort and sacrifice of the seagoing forces during the Second World War and like the *Constitution*, the *Arizona* has retained visibility.

Other conflicts: World War I, the Korean War, Vietnam, either did not make a significant impression on the nation or naval vessels did not figure prominently in the war. A measure of the degree to which conflicts have entered the national myth can be found in the relative frequency of monuments commemorating the conflict or the participants therein that have been erected in public squares and parks throughout the country. I would suggest that the monumentary evidence is congruent with the sacred ship evidence with the possible exception of the war of 1812 whose chief public monument remains the *Constitution*.

The *Monitor* today consists of a number of things. It consists of the archaeological site the wreck on the bottom of the "graveyard of the Atlantic" off Cape Hatteras; it consists of the collection of material that has been excavated from the site; it consists of materials that survived from her construction; plans, drawings and models; and it consists of the collection of data accumulated about the ship as it was and as it is; records of explorations of the site and records compiled about the vessel, her officers and crew and even the records of meetings and ceremonies concerned with the *Monitor*. The value of the *Monitor* as a symbol, as a carrier of data resides principally in this material and in the artifacts that represent the reality of the *Monitor*. This collection, like collections anywhere, requires maintenance and curation. As much as we might like to believe that our works can exist in perpetuity, man's works like his flesh are of finite duration and require maintenance to sustain what existence they may have.

The *Monitor* is now being managed in the sense that the wrecksite has been designated a National Marine Sanctuary and is under the control and is the responsibility of NOAA. Having once assumed management of the site and of its contents wherever they may roam, the responsibility of this management is perpetual. In order to exercise that responsibility prudently every action that might affect the site and its contents, including the option of doing nothing, must be evaluated in terms of its effect on the physical survival of the wreck and all related collections.

Underwater work is expensive anywhere. The deeper one goes the more it costs. The *Monitor* site is over 200 feet deep. Any work done at that depth requires a lot of expensive equipment and time. The time that people can spend working at depth in the ocean is dearly bought. The weather at the site in the "graveyard of the Atlantic" is only marginally predictable and the seas tend to be rough. Ordinary luck can see an expedition spending its valuable and extremely expensive field time watching the water go up and down hoping for better weather to be able to continue operations. In other words field research at the *Monitor* site is extremely expensive.

Because the *Monitor* is a sacred vessel not to be trifled with and since work at the site is so expensive, care must be taken to ensure that value is received for value expended and for risk taken. The principal value is the value of the vessel, its iconographic and symbolic value must be taken into account along with the expense and risk of dealing with the site. Any disturbance of the site must be done to answer real questions, to deal with important unknowns rather than to seek to reiterate information that may be available elsewhere. Because the *Monitor* is so well known and so well documented, the conventional questions that shipwrecks are excavated to answer can frequently be answered without having to disturb the resource. Since we have her builders plans, notes and at least one model we know a great deal about how she was constructed. Since we have accounts written by people who built and sailed her we know a great deal about how she worked and operated and about life on board. The most value to be gotten from excavating the site will not consist of a record of construction details or the sure knowledge that the boatswain loaded stores in one fashion rather than in another or that the crew had personal effects and which happened to be found in a certain part of the hull. The real value consists of the vessel itself, the artifact that embodies the myth.

In order to avail ourselves of the *Monitor*, to experience the reality of the *Monitor*, we have recovered pieces of her and we will quite likely continue to do so. The recovered material is the observable *Monitor* and is the palpable reality of what she represents. As such they should be chosen with great care both for exhibit potential and for physical condition, so that recovered objects can both be satisfactorily preserved and exhibited.

Since the *Monitor* is now protected in a National Marine Sanctuary, with a federal agency committed to responsible management of both her remains and of a growing collection of amplifying material in perpetuity, the main *Monitor* problem is conservation: The maintenance and preservation of the entire phenomenon of the *Monitor*.

The Wreck on the bottom is the storehouse of most of what is the *Monitor*. Since its arrival at its current resting place, the *Monitor* has been subject to the full force of a very harsh environment without benefit of maintenance and as anyone familiar with ships can attest, boats and ships require maintenance when new and most certainly do so when old. The *Monitor*, like other vessels, has been undergoing the forces of deterioration since she was launched and especially so since she sank.

Management of an historic or archaeological resource is not easy. The primary responsibility of the manager is always to maintain the value of the resource. This means that any activities that affect the resource must return more in information than they lose. Management also implies that merely leaving it alone, doing nothing to affect the resource either positively or negatively and trusting to luck for the maintenance of its value is an abrogation of the basic management responsibility of value maintenance. In order to properly manage the *Monitor* the managing agency (NOAA) must be aware of what is happening to it and be prepared to take steps to protect it if necessary.

In order to responsibly manage and protect the portion of the *Monitor* that remains in the sanctuary we need to know a number of things including its corrosion dynamics: We need to know what is corroding and how fast. We need to know the extent of the corrosion that has already occurred and we need to know the relationships of the metal parts of the vessel to one another to be able to understand just the metallic corrosion processes. There are also non-metallic parts of the vessel that have been subject to the same less than ideal conditions that must be addressed

The material that has been recovered from the *Monitor* has been conserved, that is, stabilized with the corrosion processes halted and the corrosives that had entered the material during its long immersion in salt water have been removed. Conservation stabilizes an object; it does not necessarily confer long lasting protection to it. Once conserved, maintenance and curation are necessary to insure the continued existence of the material and to ensure that they remain as a collection associated with the *Monitor* and are available and useful.

CURTISS E. PETERSON
UNIVERSITY OF SOUTH CAROLINA
SOUTH CAROLINA INSTITUTE OF ARCHAEOLOGY
AND ANTHROPOLOGY
COLUMBIA S.C. 29208

BRUCE E. RIPPETEAU

Discussant Remarks

Mr. Chairman and USS *Monitor* Symposium Participants, this large audience and I have learned much from your presentations. Your efforts can be called a new benchmark in the important row of such marks for the *Monitor's* second life.

Clearly we all owe thanks to the National Oceanic and Atmospheric Administration's Mr. Ed Miller, who envisioned this public forum for recent *Monitor* developments. And to NPS's Mr. Cal Cummings who, under contract to NOAA and with his long interest, has conducted it. Clearly, also, our speakers have thoughtfully presented information worth hearing either again or for the first time.

The *Monitor* is such a famous American national and historic artifact that we are often blinded to its physical reality as it yet lies upside-down in 230' feet of cold, dark seawater 16 miles off of Cape Hatteras, where it sank on 31 December 1862, nearly 125 years ago from today, 08 January 1987.

Since its rediscovery in 1973 after its formal abandonment by the Navy in 1953, a great deal of investigation and possibilities for recovery have not been seen. Most of the *Monitor's* second jeopardy, as I might call the recent attention compared to the 1862 blockade attention, is now sorted out. This is much of Mr. Ed Miller's "Management Framework" message, and it continues to be good to hear.

NOAA has assumed responsibility and takes it seriously. The *Monitor* is under federal protection in the form of our first National Marine Sanctuary, dedicated 30 January 1975 which was 113 years to the day after its launching. In addition to Title IV of the Marine Sanctuary, Research and Protection Act of 1972, protection for the *Monitor* also consists of a NOAA commitment to careful review of all modern impacts and the decision precept of doing it no harm.

A discussant might note that it is well that the *Monitor* came back to us as late as it did, for our 1970 and 1980s attitude has been one of "Cultural Resource Management," not of mere marine salvage.

For example, at the current time there is a certain red herring about raising the *Monitor*. Of course, it can be done, and may be done. But raising the *Monitor* will have to be a national act whose conservation will last into the next century and whose display needs will be novel.

Mr. James Delgado's paper on "A Symbol of the People" concerned the meaning of the *Monitor* to us. He tells us it has mythic properties that exemplify portions of the American Identity, particularly in the industrial ascendency of iron and steel and steam over wood and sail. Similar ships, antedating the *Monitor*, were used in Europe, for example in the Baltic naval actions. Ericsson's special use of the concept in our Civil War was something of a tactical surprise to the Confederacy.

Certainly the small size of the monitors had a heroic "David" quality to the South's ironclad "Goliaths." And further, as Delgado explains, there was a subjective human response to the *Monitor*. It inspired a sense of change and mastery, a fact Ericsson apparently intended by its name. Its mythic strength was largely undiminished after the subsequent failure in versatility of *Monitor*-class ships at Charleston.

Still, mythology is selective. For example, the other naval "Davids" were the Confederacy's steam-powered, semi-submerged torpedo boats and the man-powered submarines such as the *CSS Hunley*. And for example, the *Hunley* was lost sinking the USS *Housatonic* in Charleston Harbor in February 1864. These slealthy Davids never naturally received, or were given by the Confederate press, this heroic value of the *Monitor's* daylight duel.

I might also note, among the many points well made by Delgado, that there may have also been a certain nobility broadly attached to the *Monitor* due to its sudden, dramatic, and seemingly final departure from our surface world. The dramatic sinking was, perhaps, perceivable as a metaphoric reception by the war gods. Let us note that Submarine Boat 571, the 1950s USS *Nautilus*, led to a comparable change in naval warfare as a tactical weapons platform and for later evolution of the submarine as a hidden ICBM strategic retaliation, just as the *Monitor* led to battleship dreadnoughts. Yet the famous *Nautilus* has stayed with us in a relatively undeified public state, while the departed *Monitor* left us to our imaginations.

Mr. Gordon Watts' "Research" brought to us the modern, also high technology, romanticism of rediscovery. We can only yet personally approach the *Monitor* by pressure-resisting appliances. Even 230' down, a trivial distance to lie in front of us, is still a great life-support problem. Both by remote sensing and going with Mr. Watts and other divers, we may well sense the immensity of the artifact in its dark marine repose.

Equally a matter of technology is Mr. Curtiss Peterson's "Conservation" paper on the conservation needs of the *Monitor*. The ship is in a rest of sorts. Yet is departs us slowly by going into solution, possibly by electrolytic reactions as it may be a sort of battery with its metal armor and multiple kinds of metal pieces, and certainly by organic degradation.

We must not waste the gift we have, Peterson tells us, 125 years after it was hidden, by now inappropriately or inadequately conserving it. Clearly, the immensity of doing the job right seems to have escaped those who so facilely urge NOAA to "bring her up."

Captain Ernest Peterkin has brought a special focus to the difficult organization and quantification of the *Monitor* by his attention to "Architectural Documentation" as known from historic documents. Some of these drawings have now been made available in *Drawings of the Monitor*, *Monitor* Historical Report Service (V. 1, No. 1: 1985).

His purpose and a leading principle for NOAA's 1987 expedition, is to correlate the remote sensing impressions with the actual ship. Further he has been instrumental in proposing many engineering an architectural actions for NOAA to take as the *Monitor* is slowly "reduced-to-possession," as it were, by the power of discovery.

Finally, Dr. Larry Nordby's "Archaeological Documentation" discussed the archaeology of the *Monitor* as a wreck site. The *Monitor* is more than a wreck alone because it has a milieu beyond dry history, a milieu of the wreck field in and around it. This wreck field relates to its sinking in 1862, its depth-charging as a bottomed German Submarine in World War II, and its long-term, slow decay on a gently sloped, but moderate-energy bottom environment. All of this wreck area deserves the archaeological mindset, not only as a shipwreck but as decaying system of coherent knowledge. NOAA has done very well indeed to retain this archaeological perspective on the team.

In summary then, we see the challenge for you, Mr. Miller and NOAA, and the dimensions of the problem.

You don't need reminding that we Americans like to see our national icons. We like to stand in front of them and feel "holy" because of their actual presence, and because of a mythic tie to a heroically-perceived, and real, past.

Clearly, NOAA has basically sorted out the greater public good of not recklessly "salvaging" a popular artifact, but rather programmatically and democratically deciding its new fate as national treasure, to be conserved and managed. Let us commend NOAA and its committees for being up to our public trust for the USS *Monitor*.

BRUCE E. RIPPETEAU
UNIVERSITY OF SOUTH CAROLINA
SOUTH CAROLINA INSTITUTE OF ARCHAEOLOGY AND ANTHROPOLOGY
COLUMBIA, SOUTH CAROLINA 29208

JOHN LUIS ANTONIO DE PASSALACQUA

THE SEA WALLS OF SAINT EUSTATIUS

Introduction

Excavations were carried out on land and surveys underwater, during the summers of 1984, 1985 and 1986, at Orangestad and Orange Bay, Island of Saint Eustatius, Netherlands Antilles, emporium for contraband and commerce between this Dutch haven and Spanish and English colonies in the Caribbean Islands as well as the American Continents. This project is part of the Summer Field School Programme in Archaeology sponsored by the College of William and Mary in Virginia, the Historical Foundation of Saint Eustatius, and the Archaeological and Anthropological Institute of Curacao, with the assistance of Kathryn Bequette, at the time a graduate student at East Carolina University.

The Site

The city and its harbour were developed during the seventeenth and eighteenth centuries mainly as a trading station of the Dutch West Indies Company.

Situated on the lee side of the Arc of the Windward islands the Island of Saint Eustatius is already protected to some extent from the prevailing easterly or Alisian winds. Orange Bay itself lies on the leeward side of the Island and provides a harbour which is favorably situated as regards the winds and the sea currents, and is in a suitable geographical position for the proposed commerce it was destined to engage in.

Within the bay, close to shore and along the shoreline, several alignments of boulders can be observed. Some of these can be clearly seen lying in fairly shallow water at a short distance from the shore as seen from the parapets of Fort Orange on the cliffs above. For convenience we have divided these alignments into eight walls which are the subject of this report.

Objective of the 1985 and 1986 Seasons

The 1985 and 1986 seasons under water had four major objectives:

1. Establish and plot the position of several underwater structures on the shore and near the shore in Orange Bay;
2. Determine whether these structures are natural or man made;
3. In the latter case, determine how these structures were constructed; and
4. Determine the position of a jetty and basin proposed in 1828 and begun sometime thereafter.

Data

Wall M-4

Wall M-4 lies along the shoreline of the lower town seaward of the ruins remaining of the warehouse that once stood in this thriving port. It extends for a distance of approximately 402 metres and has the appearance of a bed of variously shaped boulders. A sample taken indicates that these are mostly granite and weigh between 25 and 35 kilogrammes.

The boulders are not now neatly piled seaward of the shore. On the contrary they have the appearance of a large quantity of stones strewn roughly in an area five to seven metres wide along the shoreline and into the water. However, there are certain points along this shoreline where it appears that an effort was made to set up a wall smoothly finished with mortar to hold the stones in place. In these areas the stones used are considerably smaller in size and weight and pieces of shell and other marine life can be observed in the mortar.

From the geological point of view, a natural origin for this alignment has been ruled out. The stones and boulders have been placed in this area through the agency of man. Yet, while there is documentary and archaeological evidence that since the late seventeenth century the inhabitants of Saint Eustatius constructed well made sea walls of mortar and rock, and may have carried out land reclamation projects, there is no evidence that those techniques were also used on this wall. On the contrary, every indication points to the laying of these boulders one upon another without any attempt to fit the shapes, shape the boulders themselves or join them together through the use of hydraulic cement or other type of mortar.

As far as Wall M-4 is concerned it appears that it was constructed essentially for the purpose of protecting to some extent those buildings which lay along the beach, that is the long line of warehouses where the goods to be transhipped were stored and which were thus essential to the economy of the island. These walls would serve to decrease the violence of the waters of the sea beating against these buildings during those rare times when the quiet waters of Orange Bay rose menacingly against the shore structures blown by the periodic hurricanes which now and then pass by this area.

Walls M-1, 2, 3, and 5

An initial examination of the structures in the bay itself, evidenced an alignment of boulders which was found lying in Gallows Bay extending 431 metres due north, at distances of 36 to 80 metres seaward.

The alignment is broken up into four segments separated from each other by as much as 30 metres between M-1 and M-2 and as little as 2 metres between M-3 and M-5. Despite these breaks in the structures, these segments do not appear completely separated but rather as a thinning of the number of boulders in that particular spot. While each segment has been given a separate number for purposes of identification, an examination of the entire structure does not evidence major differences in structure or the use of building materials, and consequently all four segments will be treated together.

An examination of the structure reveals that boulders varying from 25 to 35 kilogrammes, lie one on top of the other without any apparent attempt to shape or fit them together and without any traces of mortar or hydraulic cement found joining them. Most of the boulders are rounded in shape, however some are considerably larger and have irregular shapes, roughly rectangular or with the appearance of a thick slab. Some of these may have been used by the indigenous Carib Indians in the preparation of flower from roots and grain.

A number of boulders lie alongside the walls where they were perhaps originally dropped or where the action of the water has pushed them.

The structures in questions lie in shallow water between two and four metres deep. Although there are no records to tell us how these particular structures were constructed, it would not have been difficult to drop the boulders into place from barges of skiffs, while breathhold divers secured any which did not fall into the position intended.

On its landward side the walls rise above the sand on which they sit from as little as 5 to as much as 65 centimetres. Seaward the walls

gradually sink into the sand making it necessary to calculate their width with the aid of soundings. However, in those areas where the structures appear to be essentially above the sand, the width of these portions fluctuated between 2.30 metres and 7.13 metres.

The structure of the walls is not uniform. The action of the water and possibly of man himself has caused dissociation of the boulders in several places. In other areas ledges and small caverns and caves which are now a haven for fish, sea urchins, crustaceans and other marine animals have formed. On the walls themselves it is possible to recognize the presence of some coral formations, the most abundant of which is Millepora with some examples of Diploria and Montastrea. However, Cnidarian colonies are small and there are no examples of colonies having many years of development nor were any colonies observed which might indicate that the walls were built after the existence of the colony or actually using such colonies as part of the structure of the walls. Neither is there any evidence that the structures derive from or form part of, use natural coraligenous or rock formations.

In order to establish more clearly the nature of, and manner in which walls M-1, 2, 3, and 5 were built, it was decided to clear the southern tip of M-3 of sand down to the sea bed if possible. Thus, starting at the tip, a segment of the wall 3 metres long and 4 metres wide was chosen. A datum point was established and its geographic position was determined by triangulation from known points on land.

The tip of the southern edge of Wall M-3 sits 24 cm above the sand and consists of a number of boulders such as those described above.

A small area was dug out from under the wall showing that the boulders lie directly on the sand and not on the bedrock which lies underneath the sand. No attempt was made to take this section of the wall down.

Soundings were made to the east and west of the area examined for a distance of 5 metres in either direction. Landward, the probes would sink in to the sand between 45 cm and 60 cm before hitting bedrock. There does not seem to be any upward tilt to the shore in this area. However, on the seaward side, the probes sank in from 60 to 90 cm over a five metre line indicating a downward slant in the bedrock. The same was true for five other probe lines done on the seaward side at five metre intervals due north.

There is no documentary evidence determining when or how Walls 1, 2, 3, and 5 were constructed. However, beginning in 1828 a series of attempts at building port facilities have been recorded. (Atema, Herzog.)

The 1828 Jetty and Basin

A sketch drawn in 1828 shows a large area of land fill surmounted by a pier or jetty which juts out westwardly into Orange Bay, veering off to the northwest. The sketch shows that the jetty was planned to lie above the level of the waters in the roadstead forming a basin of calm waters that could be entered from the north through a mouth formed between the end of the jetty and an outcropping point on land.

According to the sketch, the jetty begins at a point of the strand and extends seaward a distance of 48 metres veering off to the northwest a distance of 160 metres, ending in front of another unidentified point with which it forms a mouth 61.5 metres wide. Depths marked vary from 2 to 3.5 metres. There are two buildings in the sketch one of which is identified as the Customs House (La Douane). There are no other identifying landmarks which would allow us to ascertain where the jetty was to be constructed nor are there any geographical coordinates on the sketch.

A later map shows quite clearly the presence of a structure jutting out 41 metres into the water and then turning at right angles for another 221 metres. However, an examination of the geographical coordinates on this map places the structure considerably north of the Customs House appearing on the 1828 sketch.

An underwater examination of the bay in the approximate area indicated by the maps has not revealed any structure consistent with the structures and locations therein established. However, the old customs house has been identified which may be related to the structure appearing on the 1828 sketch, although the latter does not have the same shape and may indicated a different origin or a change in plans. If this is so, according to the 1828 map the jetty should have been built approximately 140 metres to the south of the Customs House.

An examination of this area shows that there is a large amount of rubble consisting mostly of large boulders strewn about with no apparent order and some of which are quite large. The area begins at the coastline and extends seaward approximately 80 metres with a width varying between 5 and 10 metres. The area is very disassociated and its lateral boundaries are hard to determine. Pieces of masonry and a cannon are to be found in the area. It approaches wall M-3 at right angles but does not join it. Nor is there any evidence of a curvature in the wall as appears in the 1828 sketch. However, the depths recorded on the sketch coincide with those found at the site at low tide.

This rubble area lies approximately at latitude 17 degrees 28'50" North and Longitude 62 degrees 59'17" West which places it in the area of the 1828 plan and considerably south of the structures appearing on the map of the mid 1800's.

Conclusions

The studies carried out on the walls lying in Orange Bay, Saint Eustatius, have resulted in the definition of the position of a number of sea walls found in the bay and they have been related to land and geographical coordinates.

An examination of the structures has determined that they are all definitely man made, probably during the nineteenth century and possibly during the eighteenth century, at least in respect to the structures originating on shore.

Absent documentary evidence as to the particular technology used to construct these walls, it has been concluded on the basis of the walls themselves that the stones and boulders were dropped into place from the surface of the water three metres above. No attempt was made to cement the boulders together nor was any attempt made to cut or otherwise fit the boulders together.

The probable position of the jetty and basin planned early in 1828 has been identified and plotted on the basis of the documentary evidence available and an examination of the sea bottom. It appears that a change in plans or subsequent construction altered the original project and that the walls marked as M-1, 2, 3, and 5 were related to each other and were probably intended to form part or to have been joined with the pier planned in 1828.

On the other hand wall M-4 belongs to the latter part of the eighteenth century and the First part of the nineteenth being intended as a breakwater for the protection fo the warehouses existing along the strand.

Walls M-6, 7 and 8 are stone alignment begun further up the bay and were probably intended as breakwaters for the protection of land structures through the abatement of wave action. These walls appear to have been barely begun when construction ceased.

REFERENCES

ABBAD Y LASIERRA, FRAY AGUSTIN INIGO
1970 *Historia Geográfica, Civil y Natural de la Isla de San Juan Bautista del Puerto Rico*, Editorial Universitaria, Universidad de Puerto Rico, Río Piedra.

ALTAMIRA, RAFAEL
1929 *Historia de España y de la Civilización Española*, Sucesores de Juan Gili, Barcelona, 6 vols.

ATTEMA, YPIE
1981 *St. Eustatius, A Short History of the Island and its Monuments*, De Walburg Pers, Zutphen, Holland.

BAARKA, NORMAN F.
1985 *Archaeology of St. Eustatius, Netherlands Antilles An Iterim Report on the 1981-84 S Seasons*, College of William and Mary, Williamsburg, Virginia, 1985.

CARO COSTAS, ADA R.
1983 *Antología de Lecturas de Historia de Puerto Rico, (Siglos XV-XVIII)*, San Juan de Puerto Rico.

FERNANDEZ MENDEZ, EUGENIO
1981 *Crónicas de Puerto Rico*, Editorial Universitaria, Universidad de Puerto Rico, Río Piedras.

GOSLINGA, CORNELIUS CH.
1971 *The Dutch in the Caribbean and on the Wild Coast 1580-1680*, University of Florida Press, Gainesville.

HARTOG, J.
1976 *History of St. Eustatius*, De Wit Stores, Aruba, Netherlands Antilles.

LOPEZ CANTOS, ANGEL
1975 *Historia de Puerto Rico 1650-1700*, Consejo Superior de Investigaciones Científicas, Sevilla.

NAGELKERKEN, WIL
1985 *Preliminary Report on the Determination of the Location of the Historical Anchorage at Orange Bay, St. Eustatius, Netherlands Antilles*, Report of the Institute of Archaeology and Anthropology of the Netherlands Antilles No. 1, Curaçao.

VARELA, CONSUELO.
1982 *Cristóbal Colón: Textos y Documentos Completos*, Alianza Universidad, Madrid.

VILA VILAR, ENRIQUETA
1974 *Historia de Puerto Rico 1600-1650*, Escuela de Estudios Hispano-Americanos, Sevilla.

DR. JOHN L.A. DE PASSALACQUA, S.J.D.
UNIVERSITY OF PUERTO RICO
SAN JUAN, PUERTO RICO
AND
COLLEGE OF WILLIAM AND MARY
WILLIAMSBURG, VIRGINIA

MARGARET M. COWIN

Hellenistic to Early Byzantine Artifacts Found off the Southwestern Turkish Coast

Introduction

For some years the Institute of Nautical Archaeology (INA) has conducted periodic surveys of underwater sites off the southwestern coast of Turkey. During brief dives the sites are evaluated and a few representative artifacts gathered. The finds are being studied in order to learn more about ancient currents of trade.

A recent project focused on 59 artifacts from 17 sites lying roughly between Bodrum to the west and Marmaris to the east (Figure 1). Conclusions drawn from the study of these pieces emphasize well-known features of early commerce; they also bring to light some of its lesser known aspects.

It is common knowledge that traders have skirted the coast of southern Anatolia for centuries, and the range in date of the survey artifacts attests to this. The earliest find is from the twelfth century B.C., the latest from the fifteenth century A.D., a spread of about 2500 years (Table 1). Most of the artifacts, however, come from the 900 years encompassing Hellenistic to early Byzantine times (third century B.C. to seventh century A.D.).

Distribution Features

The tabulation of artifacts brings out five characteristics of the collection. First, there is a sizable group—at least 16 artifacts—attributed to the third to first century B.C. This is a larger assemblage than that of any other period. The vigor of Hellenistic trade, already established, is underlined once again.

Second, there is a preponderance of Rhodian-type amphoras, which accounts for 15 out of 38 jars. Their various styles span a period of 500 years and include examples of nearly the complete series of Rhodian jars. During the Hellenistic period Rhodes controlled parts of the Anatolian mainland so it is not surprising to have this island's mercantile power reflected in the spill of fragments along the neighboring shore. Survey amphora 80H-10 exhibits the classic Rhodian amphora-handle shape (Figure 2); a stamp of Themison dates the jar to the second half of the second century B.C. (Nilsson 1909:429 [231].

Third, in contrast to numerous Rhodian jars there are only three Knidian amphoras. Because part of the survey was probing the Knidian coast, and Knidos, like Rhodes, exported a cheap and popular wine, one might expect to find Knidian jars in large numbers here, if anywhere. Such was not the case.

A striking lack of Knidian jars in the eastern Mediterranean is noted in other studies. Knidian amphoras have been found in large

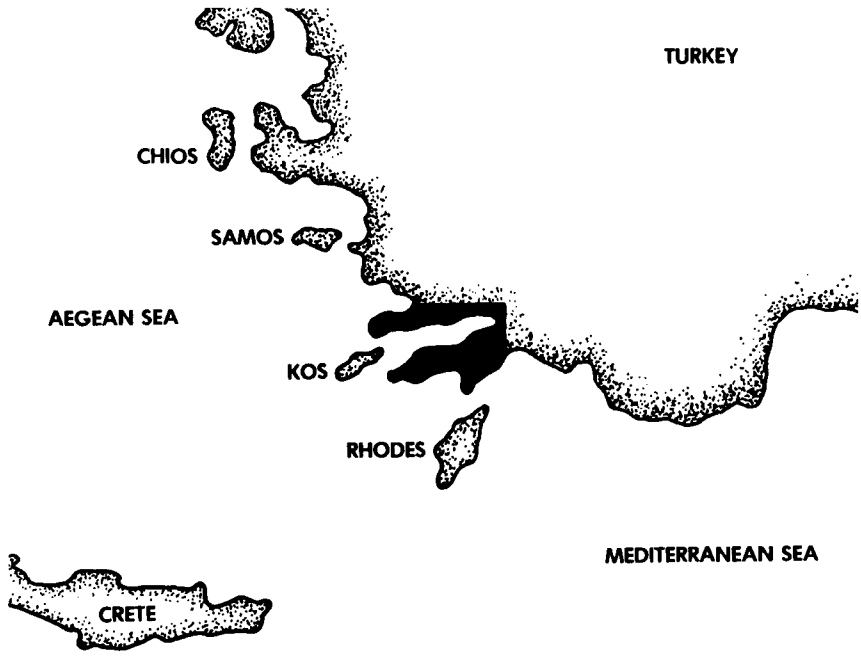


FIGURE 1. Aegean and Mediterranean Seas. The coast along the survey area is blackened.

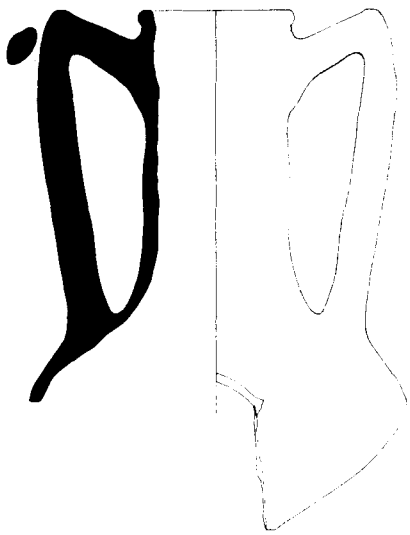


FIGURE 2. Amphora, 80B-10. Pres. h. 0.46 m.

numbers at only three land sites: Knidos itself, and two locations to the west, Delos and Athens (Grace 1934:201, Note 1). Possible explanations for what seems a surprising scarcity of these jars in home waters might be that Knidian ships had little reason to veer east toward Rhodes, and perhaps the volume of Knidian trade simply did not equal that of Rhodes.

Knidian jars of the Hellenistic period tend to echo in shape their Rhodian counterparts (Grace 1934:204, Note 2). Knidian amphora 80B-1 is dated to the first century B.C., after 86 B.C. by reference to its handle stamp depicting in relief a small amphora, a logo attributed to the potter Kleupithes (V.R. Grace, personal communication 1983) (Figure 3). This jar is a little later than Rhodian amphora 80H-10 shown in Figure 3 but the profiles are not dissimilar.

A fourth characteristic emerging from the tabulation of survey artifacts in Table 1 is the large group of finds dating to early Byzantine times (fourth to seventh century A.D.).

Finally, there is an abrupt decrease in artifacts after the seventh century A.D.; only three are placed in this period, and two of the three are given sliding dates. The dwindling in numbers is unexpected.

Serce Limani Study

A possible slowing of trading activity along the Anatolian coast after the seventh century A.D. is suggested not only by study of the survey artifacts but also by a companion study carried out by Dorothy Slane in 1979-1982 (Slane 1982). Slane catalogued surface finds

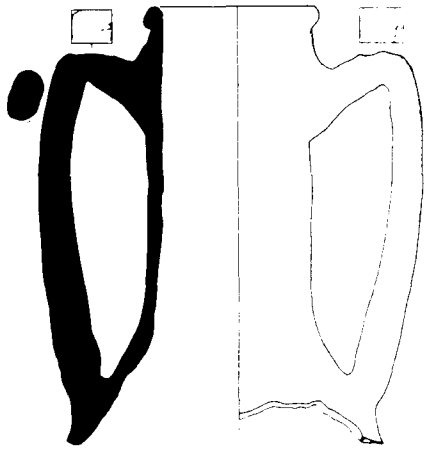


FIGURE 3. Amphora, 80B-1. Pres. h. 0.29 m.

gathered from an anchorage site at Serce Limani, a harbor on the Turkish coast opposite Rhodes.

The Serce anchorage yielded 160 identifiable finds. Excluding four very early ones, the remaining 156 artifacts extend over a time period comparable to that of our survey collection, that is, from the twelfth century B.C. to the thirteenth century A.D. (Table 2, see end page). Again, the majority of finds have dates within the middle periods, Hellenistic through early Byzantine. The total assemblage exhibits the same five characteristics as the survey finds:

1. Concentration within the Hellenistic Period. With 21 artifacts attributed to the second century B.C. alone, the emphasis is dramatic.
2. Large number of Rhodian jars. Out of a total of 82 amphoras, 11 are Rhodian, the largest identified group.
3. Small number of Knidian jars—only two
4. Sizeable group of early Byzantine artifacts (fourth to seventh century A.D.)
5. Pronounced drop-off in numbers after the seventh century A.D.

Why there is a decline in the quantity of artifacts after the seventh century is not clear. Of course, reoccurrent warfare between Byzantium and the Muslim East during these years may be a decisive factor. Yet war does not necessarily stifle trade. The Hellenistic period was marred by frequent hostilities and still saw commerce flourish.

It is known that changes in long-standing mercantile and shipbuilding practices occurred in the seventh century. About this time state-organized commerce became less important, and sea captains began to trade as independent merchants (Lopez 1959:79). One result may have been reduced volume overall. Coincidental or not, the period also saw a new approach to shipbuilding. A seventh-century merchantman excavated at Yassi Ada, Turkey incorporates both ancient and modern techniques (Bass and van Doorninck 1982:311-312). The innovative shell-first technique used to assemble the upper hull of this transitional vessel meant that ships could be assembled quicker and cheaper than formerly. Use of the new technology may have been encourage by these businessmen with limited budgets.

A further explanation for the apparent decrease in finds after the seventh century at the Serce anchorage is noted by Slane: the scarcity of published late Byzantine coarse ware with the result that some unidentified anchorage finds may, in fact, belong to this later period (Slane 1982:195).

In any event, concordance between the two studies regarding late Byzantine trade suggests the topic merits additional research.

Bag-like Amphoras

Among the survey artifacts are several examples of bag-like amphoras, a type less well known than Rhodian or Knidian jars. Amphora 80E-2 belongs to this type (Figure 4). The body is full with its maximum diameter in the lower half; the body surface is decorated with combing and ridges. A cylindrical neck bulges beneath a roll rim; the neck is collared with a faint but unmistakable vertical band where neck meets shoulder. The toe is a tapering peg, slightly splayed and flattened on the bottom. The profile of the toe is somewhat similar to that of amphora toe 80E-1, recovered from the same site (Figure 5).

The shoulder of the jar carries a graffito MA. It is likely that the marking establishes jar capacity. A container of the late fourth

FIGURE 4. Amphora, 80E-2. H. 0.68 m.

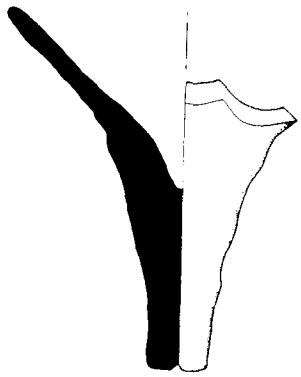


FIGURE 5. Amphora toe, 80E-1. Pres. h. 0.16 m.

century A.D., similar in shape and size, is marked with Greek letters that translate into the number 37 1/2, indicating perhaps a jar capacity of 37 1/2 zestai (Robinson 1959:109-10 [M273]). The letters MA translate into the number 41 and may indicate that this jar contains 41 zestai. Unfortunately, its actual capacity has not as yet been measured. Of published examples the body is closest in shape to those of amphoras from a fourth-century A.D. wreck at Yassi Ada (Bass and van Doorninck 1971:34 [Type 1] and Plate 2.8).

The jars belongs to a general type in existence from the third to the sixth century A.D. This family of amphoras has a body that is full and symmetrical in the third century but with the passage of time the body tends to become more irregular in profile and bag-like (Scorpan 1976:158 [Type 11-I]).

Jar top 80H-4 is from an amphora belonging to one of the later generations of the family (Figure 6). The workmanship is cruder than that of the MA jar, but absence of the body leaves exact date uncertain. Amphora 7414 from the Bodrum Museum is a variant of the type (Figure 7). The Bodrum jar stands on a toe having a pointed end, rather like an acorn cap with stem, instead of on a flattened end, as does the MA jar. Several similar "acorn cap" toes, such as 80H-9 (Figure 8), are among the survey finds. Other similar jars have cone-shaped toes (Isler 1984:Plate 85).

"Bean pot"

Some of the survey finds are uncommon, some possibly even one-of-a-kind examples of ancient pottery.

"Bean pot" 80E-4 was recovered from the same site as the MA amphora (Figure 9). Pottery with a similar blocky look, ring handles and decorative groove on the shoulder has been recovered from the Adriatic, but no exact parallel for the pot is known (Vrsalovic 1974:Numbers 180 and 181). It may share with the associated MA amphora a fourth-century A.D. date; both are sturdy, carefully made pieces.

Bowls

Three unusual bowl fragments are part of the survey collection. One of them, 80H-3, seems to be a unique example of a mold-made bowl, having angled shoulders, narrowed mouth with shot upstanding rim, and improvised "inchworm" handles (Figure 10). No parallels have been found for the uncommon shape. It was perhaps an individual potter's response to the mold-made bowl mania sweeping the Mediterranean during Hellenistic times. That these bowls were put sometimes to creative uses is illustrated by a pitcher that uses an inverted mold-made bowl as shoulder (Baur 1941:241 [208] and Figure 10).

Another Hellenistic bowl fragment, 73R-4, has a cameo in the bottom (Figure 11). The relief depicts a cupid. An identical cupid cameo is reported from an Alexandrian site dated to the Ptolemaic period (Shenouda 1973:203 [Figure 52]). Ties between Egypt and the Aegean are long-standing.

A third bowl, 73D-3, is the size of a cereal dish (Figure 12). The walls, which measure about a centimeter in thickness, are massive for the bowl's small size. The surface is finished with a heavy layer of slip that has flaked off in some areas to expose a rough undersurface marked with a graffito in the shape of a double axe. The graffito would be concealed by an intact coating. The bowl is undated.

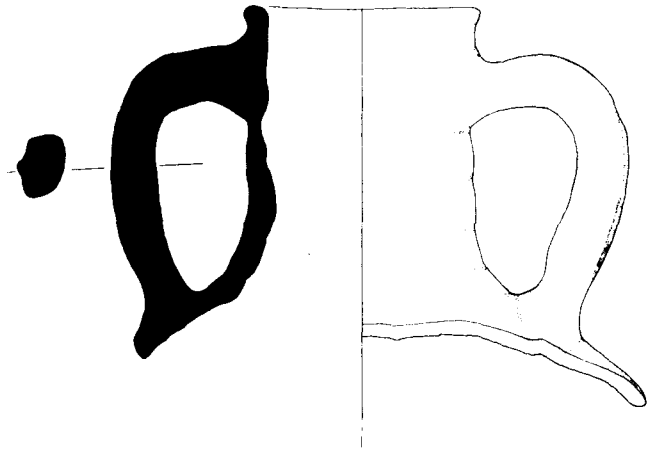


FIGURE 6. Amphora, 80H-4. Pres. h. 0.18 m.

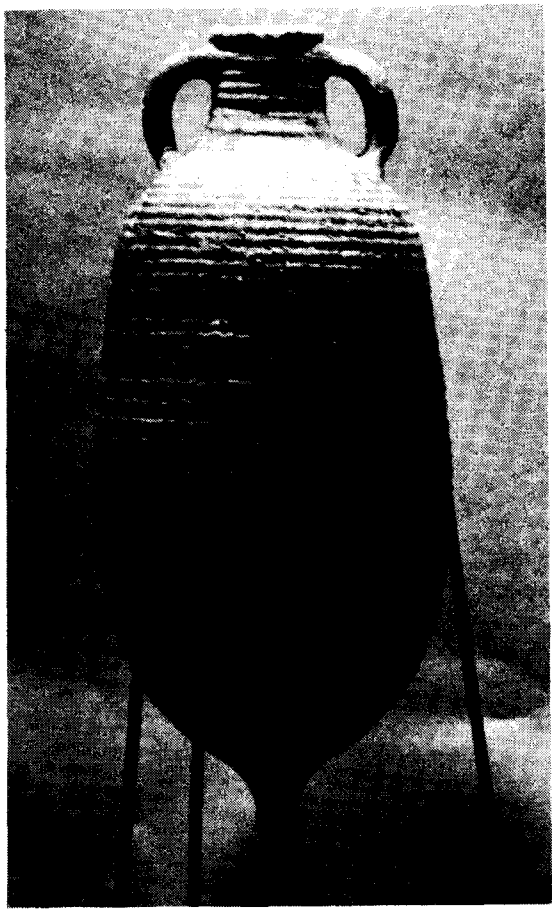


FIGURE 7. Amphora, Bodrum Museum 7414. H. 0.73 m.

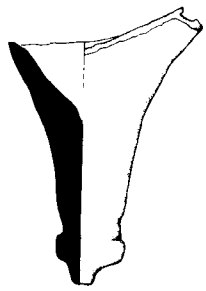


Figure 8. Amphora toe, 80H-9. Pres. h. 0.12 m.

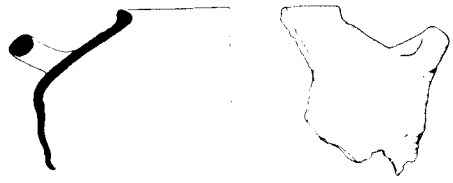


FIGURE 10. Bowl, 80H-3. Pres. h. 0.08 m.

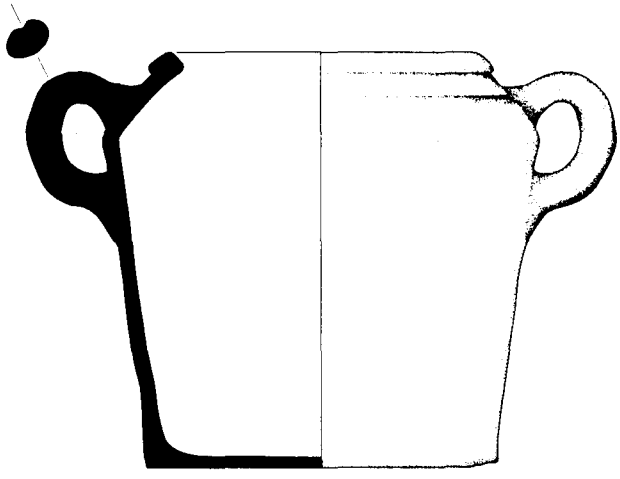


FIGURE 9. Pot, 80E-4. H. 0.18 m.

"Steam pot"

One puzzling lid-like object, 80K-1, is surmounted by a hollow knob (Figure 13). Lid and knob are separated by a clay membrane, which is pierced with an irregular, finger-sized hole. The mouth of the knob draws in, suggesting that whatever passed through it was intended to concentrate in the process; the shape of the knob is not unlike that of the nozzle of a present day vaporizer. A similar, if considerably smaller, object is reported from Byrsa, Tunisia, and identified as an incense-burner top (Ferron and Pinard 1960-61:149 [436] and Plate 76).

Conclusion

While study of the survey artifacts from the 17 underwater sites emphasizes some elements of early trade that are well known, that is, the long history of commerce.

Acknowledgements

I am indebted to V.R. Grace and to F.H. van Doorninck, Jr. for sharing their extensive knowledge of amphoras. Oguz Alpozen, Director, Bodrum (Turkey) Museum of Underwater Archaeology, kindly allowed the Museum jar to be included. The map is by Anne Cowin; the drawings are by Jo-Ann Sharp, Mary Apple and the author; the photos are by the author.

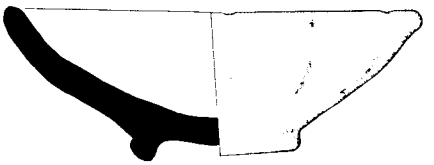


FIGURE 12. Bowl, 73D-3. H. 0.06 m.

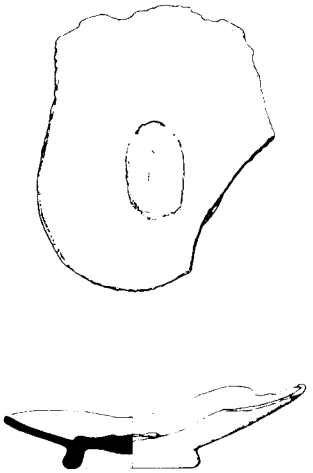


FIGURE 11. Bowl, 73R-4. Pres. h. 0.03 m.

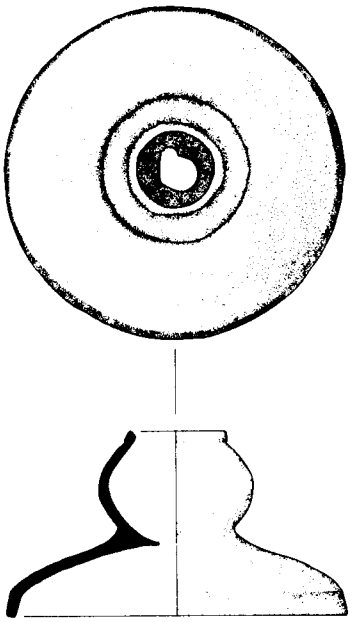


FIGURE 13. "Steam top," 80K-1. H. 0.08 m.

TABLE 1

SURVEY FINDS GROUPED BY PERIOD

Period	Total Finds
B.C. 12th	0
7th - 4th	000000000
3rd - 1st	RRRRRRR 0000000 KKK
A.D. 1st - 3rd A.C.	RRRRRRRR 00
4th - 7th	0000000000000000
8th - 11th	
15th	0

Note: "0" indicates unspecified artifact
"R" indicates Rhodian jar
"K" indicates Knidian jar

TABLE 2

SERCE LIMANI ANCHORAGE FINDS
GROUPED BY CENTURY

Century		Total Finds
B.C.	12th	000
	11th	00
	10th	0
	9th	00
	8th	000
	7th	000000
	6th	00000
	5th	0000000
	4th	00000
	3rd	RRRRRR 0
	2nd	RRRRR 00000000000000 KK
	1st	00000000
A.C.	1st	00000000000000000
	2nd	RRR 0000
	3rd	0000000000000
	4th	0000
	5th	0000000000
	6th	000000000000000000
	7th	000000
	8th	000
	9-10th	00
	11th	00
	12th	0
	13th	0

Note: "0" indicates unspecified artifact
"R" indicates Rhodian jar
"K" indicates Knidian jar

Source: D.A. Slane, The History of the Anchorage at Serce Liman, Turkey (M.A. thesis, Texas A & M University 1982)

REFERENCES

BASS, G.F. AND F.H. VAN DOORNINCK, JR.

1971 A Fourth-Century Shipwreck at Yassi Ada. *American Journal of Archaeology* 75:27-37.

1982 *Yassi Ada I: A Seventh-Century Byzantine Shipwreck.* Texas A&M University Press, College Station.

BAUR, P.V.C.

1941 Megarian Bowls in the Rebecca Darlington Stoddard Collection of Greek and Italian Vases in Yale University. *American Journal of Archaeology* 45:229-248.

FERRON, J. AND M. PINARD

1960-61 Les fouilles de Byrsa (suite). *Cahiers de Byrsa* 9:77-170.

GRACE, V.R.

1934 Stamped Amphora Handles Found in 1931-1932. *Hesperia* 3:197-310.

1983 Personal communication

ISLER, H.P.

1984 Heraion von Samos: Eine fruhbyzantinische Zisterne. *Mitteilungen des Deutschen Archaeologischen Instituts, Athenische Abteilung* 84:202-230.

LOPEZ, R.S.

1959 The Role of Trade in the Economic Readjustment of Byzantium in the Seventh Century. *Dumbarton Oaks Papers* 13:67-85.

NILSSON, M.

1909 *Timbres Amphoriques de Lindos.* Exploration archeologique de Rhodes, vol. V. Bianco Luno, Copenhagen.

ROBINSON, H.S.

1959 *Pottery of the Roman Period: Chronology.* The Athenian Agora, vol. V. American School of Classical Studies, Princeton.

SCORPAN, C.

1976 Origini si linii evolutive in ceramica romano-bizantina (sec IV-VII) din spatiul Mediterranean si Pontic. Pontica 9:155-185.

SHENOUDA, S.

1973 Alexandria University Excavations on the Cricket Playgrounds at Alexandria. *Opuscula Romana* 9:123-205.

SLANE, D.

1982 *The History of the Anchorage at Serce Liman, Turkey.* M.A. thesis, Texas A&M, University, College Station.

VRSALOVIC, D.

1974 *Istrazivanja i Zastita Podmorskih Arheoloskih Spomenika u sr Hrvatskoj.* Republic Office for Protection of Monuments, Zagreb.

MARGARET M. COWIN
c/o INA
P.O. DRAWER AU
COLLEGE STATION, TX 77840