SUPPORTING UNDERWATER ARCHAEOLOGY WITH OCEAN TECHNOLOGY

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ABSTRACT

The Yorktown Shipwreck Archaeological Project has employed ocean technology for the location, assessment and excavation of shipwrecks from the Battle of Yorktown, 1781. A total of nine shipwrecks was located, using remote-sensing surveys. The best-preserved of the shipwrecks was excavated using a unique method: a steel enclosure, or cofferdam, was constructed around the shipwreck, and filtration systems were used to clarify the enclosed water, thus alleviating strong currents and near-zero visibility which hampered previous research. During the excavation, recording was accomplished using a three-dimensional measurement system. Final hull measurements were recorded with a device which utilizes high-frequency sonic signals to provide precise measurements. A computer-aided design and drafting (CADD) system provided analysis and report-quality drawings.

INTRODUCTION

In the fall of 1975, a small group of archaeological volunteers, with assistance from state archaeologists, began a study in the York River which eventually became a full-scale research project for the Commonwealth of Virginia. Those archaeologists located and reported on the remains of a large wooden ship believed to have been lost during the Battle of Yorktown, 1781. At least 26 British vessels were sunk during that famous battle, which proved to be the last major battle of the American Revolution. Unfortunately, however, strong currents, near-zero visibility and persistent stinging jellyfish hampered diving activities, thus limiting the effectiveness of the archaeological team.

During the years that followed, numerous applications of ocean technology were utilized in a coordinated effort to locate, evaluate and excavate ships from the sunken fleet at Yorktown.

LOCATING AND EVALUATING THE SHIPWRECKS

Beginning in 1976, the Virginia Historic Landmarks Commission (now the Virginia Division of Historic Landmarks, Department of Conservation and Historic Resources) coordinated a series of technological and archaeological studies. In 1976 and 1977, with support from the Magnetics Branch of the David W. Taylor Naval Ship Research and Development Center, Annapolis, Maryland, and the Virginia Institute of Marine Science, Gloucester Point, Virginia, two magnetometers were utilized for locating additional shipwrecks at Yorktown. Shallow areas were surveyed with a Schonstedt high-balance gradiometer, while deep-water areas (as deep as 90 feet, or 27 meters) were searched with an AN/ASQ 81 magnetometer. Almost 300 magnetic anomalies were recorded and plotted on a large-scale map.

In 1978, the Landmarks Commission received a one-year survey grant from the National Endowment for the Humanities, thus formally establishing the Yorktown Shipwreck Archaeological Project. The first project activity was to survey the same areas near Yorktown with a Klein Associates Hydroscan 530 sonar, which has both side-scanning and bottom-penetrating capabilities. Sixteen primary and 35 secondary sites were identified, many of which correlated closely with previous magnetometer data.

All remote-sensing data were correlated and primary zones were established for diver investigations. The follow-on surveys by underwater archaeologists resulted in the verification of nine British shipwrecks from the Battle of Yorktown: six were parallel to the Yorktown shoreline, two lay in shallow water on the opposite shore, near Gloucester Point, and the ninth was in the deep water of the main channel. In 1980, with the assistance of an archaeological team from Texas A&M University, one of the Gloucester Point sites was positively identified as the remains of the largest British warship, HMS CHARON.

THE COFFERDAM EXCAVATION

One of the shipwrecks, referred to by its archaeological site designation, 44YO88, was found to be in an excellent state of preservation. The state archaeological team felt that complete excavation of the ship would yield new information on 18th century

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ship construction and warfare; however, they felt that it would be very difficult to conduct the excavation in the adverse environment of the York River.

The same problem had plagued earlier archaeological diving. In 1976, the state contracted with archaeologist Dr. George F. Bass, Texas A&M University, to conduct a survey of one of the Yorktown shipwrecks. In an attempt to offset the poor diving conditions, Bass and his team constructed a floating cofferdam designed to isolate a portion of the wreck and filter the enclosed water. The system, which had to be constructed hurriedly and on a small budget, was not successful, but the concept appealed to the state team when they began long-range planning in 1979.

A new proposal was prepared, this one calling for the construction of a rigid steel cofferdam to surround 44YO88 and for the installation of a filtration system to clarify the enclosed water. The project was constructed in 1982 with funds from the U. S. Department of the Interior, the National Endowment for the Humanities, the Commonwealth of Virginia, the National Geographic Society and numerous other corporate and private sources. Such a cofferdam had been proposed before but never built; cofferdams had been used on several occasions for shipwreck excavations in Europe, but all had been constructed in shallow water, with the enclosed water being removed for a dry-land-style excavation. The Yorktown cofferdam was the first to create a "swimming-pool" environment in a silty, algae-rich river.

The Yorktown cofferdam is constructed of interlocking sheet steel pilings to form an enclosure 97 feet (27.4 m) long by 45 feet (13.6 m) wide. It should be noted that since the ship would have been built using the English system of measurement, that same system was used throughout the Yorktown project. With a water depth at the site of approximately 20 feet (6.1 m.), the cofferdam encloses approximately one-half million gallons (1,892,500 l.) of water, which is being filtered by commercial swimming pool filters donated by the Purex Corporation. Two separate filtration systems are employed, each using an electric pump to circulate water through a bank of sand filters.

Initially, the system did not work as expected. River water was freely exchanged with cofferdam water through seams in the walls and through the porous silt and clay in the river bottom. Introduction of river water brought new silt and algae to be removed and limited the effectiveness of the filters. Then, in 1985, the Ecolochem Corporation of Norfolk, Virginia, offered long-term assistance with the problem Ecolochem, the largest mobile filtration company in the world, conducted a series of tests and monitored the filters around the clock. From late 1985 to the close of the project in 1988, average visibility was better than ten feet, compared to near-zero in the open river; visibility occasionally reached as much as 30 feet (9.1 m.), permitting excellent photographic recording of the site.

As a result of the cofferdam's success, the project was reported in the June, 1988 issue of National Geographic magazine, and also featured in the BBC-TV documentary "Discoveries Underwater."

Each year since 1982, research has been conducted at the site in cooperation with the Program in Maritime History and Underwater Research at East Carolina University, Greenville, North Carolina. This cooperative research has helped refine excavation and recording methodologies and has provided an excellent training opportunity for students pursuing an advanced degree with a specialty in underwater archaeology. Within the protective confines of the cofferdam, students do not have to contend with the hostile environment posed by most coastal or riverine sites; instead, they can concentrate on archaeological methodology. The cofferdam is an ideal training situation.

Silt was removed from the site by airlifts, often referred to as "underwater vacuum cleaners." These devices use compressed air to create a suction in a rigid hose or pipe. The suction is used to remove silt and clay from the wreck site. As artifacts were exposed, they were recorded using a variety of techniques. The main recording system utilizes a three-dimensional measurement and calculation scheme devised by Charles Mazel. Three surveyor's tapes are pulled from known reference points to an object being located; these direct tape readings are then converted to rectilinear coordinates using a simple computer program.

This same measurement job can now be done electronically using the Sonic High-Accuracy Ranging and Positioning System (SHARPS). This device, developed by Applied Sonics Corp. and distributed by Marine Telepresence Inc., Poquasset, Massachusetts, utilizes sonic signals and associated computer hardware and software to locate objects quickly and with a very high degree of accuracy. The system was given its first field test at the Yorktown cofferdam in 1985, then used in 1987 to record in detail the hull shape of 44YO88.

Following data collection, SHARPS data were transferred by phone link to a Prime mini-computer at the Virginia Beach facilities of Advanced Marine Enterprises, where a computer-aided design and drafting (CADD) system helped generate detailed drawings of the hull and other key features. This combination of electronic data-gathering and computer processing provides a rapid and efficient flow of data from field to final drawings.

THE SHIPWRECK, 44YO88

The technology discussed above has produced a wealth of data on Yorktown shipwreck 44YO88. The vessel was a merchant ship which had been leased by the British Navy

for use as a supply ship during the Revolutionary War. From its boxy shape and heavy construction, the ship is believed to have been built in England as a collier, or coal-carrier. It was a brig, a two-masted ship with square sails, rated at approximately 170 tons. A hole found in the ship's starboard side verifies that it was one of a group of ships purposely scuttled to produce a barricade against an amphibious landing on the Yorktown beach.

The ship's structure contains several unusual features, especially in the construction of bow and stern, which include horizontal timbers in place of cant frames.

Objects found within the hull indicate that the captain had a well-appointed cabin, with fashionable furniture, panelling with raised molding, and a unique china cabinet. Dozens of intact barrels carry markings indicating a variety of contents including beef, pork, grains and other supplies.

CONCLUSIONS

Ocean technology made numerous significant contributions to the Yorktown Shipwreck Archaeological Project. From the remote-sensing surveys which helped locate the shipwrecks, to the cofferdam technology and, later, the recording techniques utilized at the site, ocean technology was involved in every phase of the research. It is hoped that in the future there will be even more interchange of ideas, methods and skills between underwater archaeologists and marine engineers, which will enhance even further the efficiency and accuracy of underwater excavation. In turn, underwater archaeologists will produce further evidence of America's rich maritime heritage.