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Dr. Deborah Carlson
President, INA

2011 in Review

A Letter from the

President

I hope you enjoy this fifth volume of the *INA Annual*, showcasing 10 major projects carried out under the INA flag in 2011.

Those readers acquainted with INA's work around the world will recognize that more than a few of the projects in this issue are familiar—they are some of the many ongoing, in-depth, multi-year projects that characterize INA's commitment to thorough excavation and meaningful scholarship. It is not uncommon for an INA excavation to last for many field seasons, drawing upon the expertise and dedication of colleagues and supporters around the globe.

Two major INA shipwreck excavation projects in the Mediterranean drew to a close in 2011 after multiple summer field seasons: the Phoenician shipwreck at Bajo de la Campana, Spain, and the Hellenistic column wreck at Kızılburun, Turkey. The directors of these two projects are well aware what awaits them: years in the laboratory overseeing the conservation and reassembly of the artifacts they recovered; years in the library poring over publications from other sites to find the best parallels to help narrow the date of their own assemblages; many more years studiously measuring, examining, sampling and analyzing every last fragment of material culture in an effort to reconstruct the last voyage of the ship that has become a consuming passion of their own lives.

As INA excavation directors, we know what awaits us at the post-excavation stage because our own colleagues—INA Research Associates and Affiliated Scholars—are living it every day, whether they are scrutinizing the construction techniques of exquisitely preserved ships from the Byzantine harbor at Yenikapı, Turkey, diving deep into the dusty manuscripts of the Venetian Archives, or recounting the heartbreaking loss-of-life that occurred when an Ottoman frigate was destroyed by a typhoon in the Sea of Japan at the end of a year-long voyage.

Other INA projects are consuming and challenging for other reasons, whether it be the ongoing search for remnants of a battle that represents a defining moment in Vietnamese history, or the seemingly insurmountable task of recording, preserving, and protecting the riverine relics of one of North America's most evocative spectacles—the Yukon Gold Rush. Whatever aspects of maritime history or nautical archaeology speak to you most, I am confident that you will find something of interest in this volume of the *INA Annual*.

When we're not in the field, we're working hard to improve the INA experience and grow our membership. In the last year we've made key improvements to the INA website, including online access to past issues of the *INA Quarterly*, new project blogs, more content highlighting relevant publication titles, and an *in memoriam* page honoring those who have shaped both the field and the organization. We have revived our photographic and video fulfillment system with a dedicated archivist, have added new merchandise to INA's online store, and we are continuing the conversation with friends of INA around the globe through our social media efforts on Facebook.

As always, I value your support of INA research; history depends on INA and we depend on you.

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To learn more about the growing record of projects undertaken by INA over more than five decades of exploration, go to **inadiscover.com**.



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Mark Polzer holds degrees in Chemical Engineering and Anthropology (Nautical Archaeology) from Texas A&M University, and is a Prescott Doctoral Candidate at the University of Western Australia. His dissertation research is focused on Phoenician maritime trade and colonial activity in Iron Age Spain. Mark's expertise is in Archaic seafaring and early shipbuilding in the eastern Mediterranean. He is a National Geographic Explorer and multiple grantee of the Society's Expedition Council, and is currently a Research Associate and part-time lecturer in the Dept. of Archaeology at Flinders University.

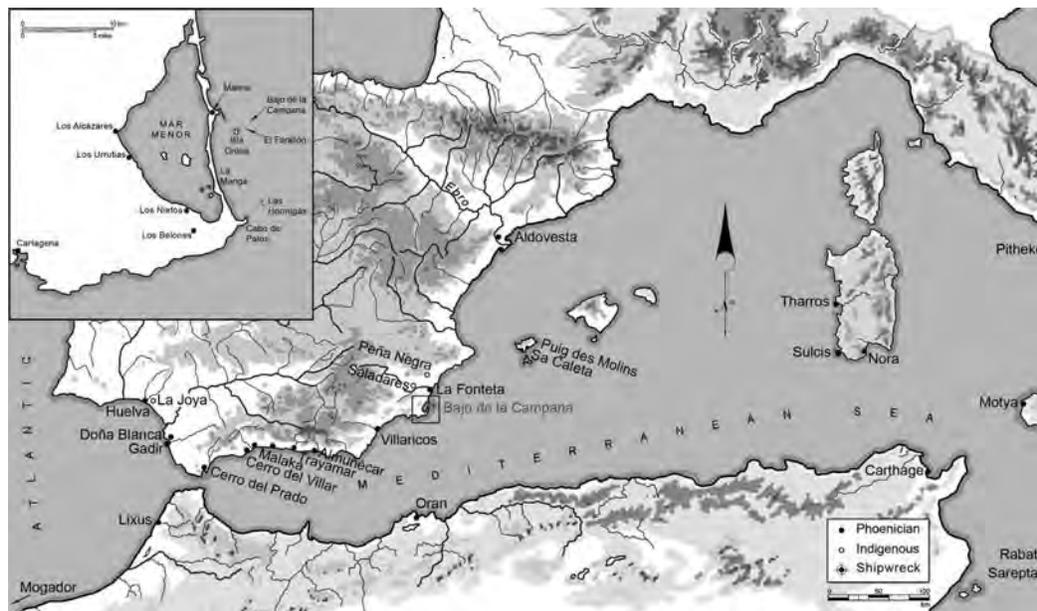


Juan Pinedo Reyes, INA

From 1987–1995, Juan worked for Spain's National Museum of Maritime Archaeology (ARQUA) in Cartagena where he co-directed the excavation of the Mazarrón 1 shipwreck at Playa del Isla. Since 1995, he has engaged in commercial archaeology through his company Arqueomar, highlighted by the excavation of six shipwrecks off the island of Escombreras. These wrecks span the 1st century B.C.E. to the 13th century C.E. and objects from the site are featured in the ARQUA Museum in Cartagena. Juan is currently assisting ARQUA staff with their survey and documentation of submerged sites along the Murcia coast.

THE FINAL SEASON OF THE Claude and Barbara Duthuit* Expedition to Bajo de la Campana, Spain

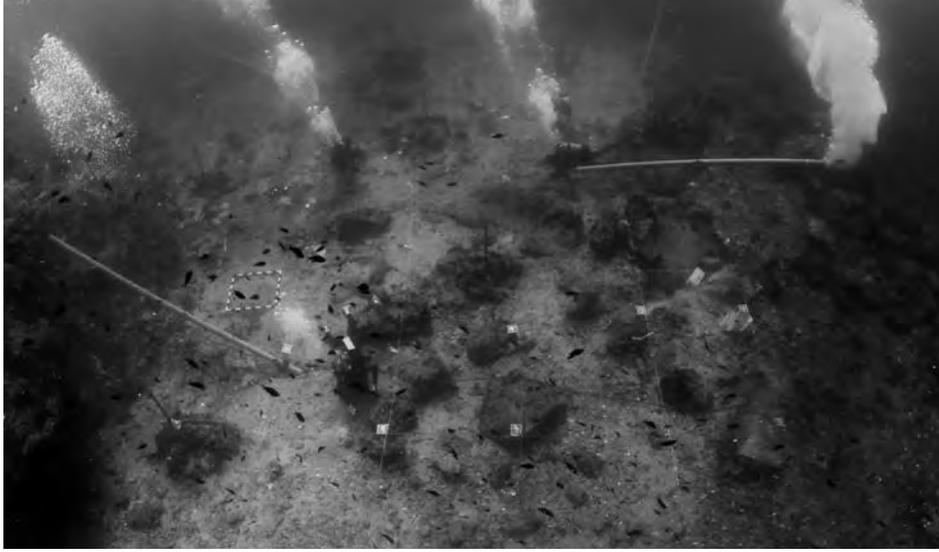
EXCAVATION OF A LATE SEVENTH-CENTURY B.C.E.
PHOENICIAN SHIPWRECK



Sometime towards the end of the seventh century B.C.E., a modest-size vessel carrying a mixed cargo of raw and finished goods set sail from a Phoenician port along the south coast of Spain and headed east (Fig. 1). The voyage progressed uneventfully until the ship rounded Cabo de Palos, a rocky spit of land jutting out into the sea where the coast turns northward. There the ship ran headlong into an unexpected, strong easterly wind, the *Levante*, which forced its bow leeward and pushed the vessel in closer to shore. The helmsman did well to avoid the shallow shoals and rocky islets of Las Hormigas and to steer the ship past Isla Grosa and El Farallón rock. But the final hazard, the lurking shoal of La Laja, better known today as Bajo de la Campana, proved to be the ship's doom.

The vessel struck the top of the shoal on its eastern side, where three large heads of rock reach up to the surface and form one side of a large fissure. The collision tore a gaping hole in the bottom of the hull, through which much of the ship's heavy cargo spilled out and into the rock crevice beneath. The ship itself likely was bashed several more times against the rocks before sinking and coming to rest a short distance from the base of the shoal on the rocky seafloor some 18 meters below.

There the shipwreck remained for two and a half millennia, battered repeatedly by violent winter storms, pieces of it strewn across the seabed and larger sections dashed up against the shoal by the churning turbulent sea. Most of the ship itself—the wooden hull, upper works, mast, rigging, and sail—was quickly swept away or broken up and devoured by marine organisms. But small bits and pieces were trapped in the shallow cave at the base of the shoal or caught in small cavities between the rocks on the seabed. Here also sediment collected, providing a protective covering for the meager fragments. Elsewhere, pottery vessels and resilient objects of stone and metal lay scattered across the



site. Gradually, much of the area was covered with a thin layer of sediment and overgrown by a large meadow of sea grass.

In the recent past, human intervention further altered the site. Explosive demolition of the top of the shoal, to increase the depth of water over it, sent tons of boulders and rock debris tumbling down onto the surrounding seabed, smashing pottery and breaking other remnants of the ship and its cargo. The subsequent dynamiting of iron hulks from modern shipwrecks further damaged the ancient remains, leaving only the most sturdy or deeply buried artifacts intact.¹

Such is the account of this shipwreck that has emerged based on observations of the site and the condition of materials recovered during excavation.² The last excavation campaign took place from June to September 2011, with financial and logistical support from INA directors (past and present) and friends, namely Claude and Barbara Duthuit, the project's namesakes, Lucy Darden, David Hadley, and Peter Way, the National Geographic Society, and the Center for Maritime Archaeology and Conservation at Texas A&M University. Due to the diligent efforts of the expedition team, the Phoenician shipwreck excavation was finally brought to completion after five consecutive seasons of fieldwork. The conservation, research, and analysis of the many finds continue, however, and are now providing the data and information needed to illuminate additional questions about the ship's story—where did the ship come from and where was it going; who was onboard; what type of commercial venture does it represent; for whom was the merchandise intended?

The 2011 Campaign

Based on last year's finds and fieldwork, the plan for 2011 was 1) to finish clearing boulders from the crevice and complete its excavation, and 2) to push farther down slope at the opposite end of the site.³ Significant discoveries in that area in 2010 pointed to a continuation of wreck material to the east and the need to expand the site in order to reach its lower limits. Once again, this meant that the team would have to move a large quantity of rocks and boulders—some of considerable size—to clear the way for excavation (Plate 1—p. 65).

Work commenced on June 6 and lasted 16 weeks (Fig. 2, Plate 2—p. 65). Over the course of the summer, the expedition team made more than 1,300 dives on the site and spent over 1,000 hours working under water, while excavating 240 m² of seabed (Plate 3—p. 65). As expected, the crevice and cave contained deep sand and boulders and were rich in archaeological material. The downslope sectors had varying levels of overburden, with deep pockets of sediment scattered around the site, but a generally thinner covering farther

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FIG 1
Bajo de la Campana shipwreck location and sites mentioned in the text (M. Polzer).

ABOVE

FIG 2
(L) Looking downslope across the main portion of the site. (R) View of the Bajo and crevice. July 2011 (S.H. Snowden).



down slope. In spite of this, these areas yielded a surprising amount of material.

The Finds

Approximately 1,300 lots of artifacts were raised by the team in 2011, representing almost 12,000 individual fragments and objects. Highlighting the finds are an assemblage of well-preserved ceramic vessels, several tools and implements, and a variety of luxury items, all of which include new object types for the wreck.

Ceramics

The pottery encountered in 2011 continued a trend observed the previous year, with substantial numbers and varieties of vessels. One of the first discoveries of 2011 was an intact Phoenician dipper juglet found in the crevice (Fig. 3; Plate 4—p. 65). A second, smaller juglet, with a single, large ring handle that rises beyond the lip of the vessel, came to light later in the season at the uppermost extent of the cave (Fig. 4). These vessels are the first of their kind found on the wreck. Similar small jugs are fairly common in both the western and eastern Mediterranean, but no examples from Spain so far show these exact body shapes. The crevice also yielded an intact oil lamp with two nozzles (Fig. 5), another first, and several more globular oil bottles (Fig. 6).⁴ Lamps with two nozzles are found almost exclusively in the western Mediterranean, and this one is similar to examples from Doña Blanca (Cádiz), Laurita (Almuñécar), and Trayamar (Morro de Mezquitilla) along Spain's southern coast.⁵ Several are known on Ibiza, from the site at Sa Caleta and from tombs in the necropolis at Puig des Molins.⁶

The globular bottles were containers for scented oils, perfumes, or ointments.⁷ These ceramic vessels are distributed widely across southern Spain and were imported from the East specifically for indigenous trade.

Shape characteristics of the Bajo de la Campana examples seem to date the vessels to the seventh century B.C.E., and probably towards the end of that century.

Additionally, the team raised an impressive assortment of tripod bowls from the crevice and from sectors farther down slope. These dishes generally are thick coarse ware and stand upon three legs that are triangular or trapezoidal in section. The type evolved from stone mortars that are commonly found on first millennium sites B.C.E. in the Near East.⁸ Tripod bowls are emblematic of the western Phoenician pottery repertoire and have been found across southern Iberia and along the entire east coast; from Mogador to Carthage in North Africa; and at colonial sites on Sardinia, Sicily, and Malta.⁹ Like the oil bottle, this vessel type is rather rare in the East. However, tripods found in Iron Age levels at several Near Eastern sites firmly establish the stylistic origins of western tripod bowls.¹⁰ The bottom exteriors of two large specimens discovered this summer are decorated with incised concentric circles, an archaic motif commonly found on earlier painted pottery (Fig. 7).¹¹ While tripod bowls are widespread, they are not typically found in large numbers, which makes the shipwreck's collection noteworthy.

Other ceramic vessel types represented in the pottery assemblage include transport amphoras, cooking pots, jars, pitchers, plates, bowls, and urns. These were found mostly as broken sherds, and few complete, so their forms and numbers will not be known for certain until they emerge from conservation and can be reconstructed and studied further.

Bulk Cargo, Implements, Tools, and Miscellaneous Finds

A good many of the finds from 2011 duplicated what had been excavated in previous seasons. The team recovered nine more elephant tusks, bringing

the total consignment of ivory to well over 60 pieces.¹² One interesting and unique example from this season is a cut section of raw ivory, whereas all others have been whole tusks. Excavation produced seven more ingots—all circular, plano-convex types, five of which are tin and two copper—along with numerous additional fragments. This was a dramatic departure from the number of ingots raised in the last couple of seasons, and brings the total number of whole ingots to 154 of tin and 13 of copper. Galena was again prolific in all regions of the site, but especially within the confines of the crevice. Excavation there exposed a thick layer of large galena nuggets that delimited the wreck stratum. Approximately 2,000 pieces were collected by summer's end (Fig. 8). A wooden stave and fragmentary remains of basketry, found in association with the galena, suggests that the lead ore, and probably metal ingots as well, was stowed in sturdy baskets within the ship's hold and was some of the first material to spill out when the ship's hull was opened.

Pan-balance weights were found all around the site, but predominantly across its eastern edge. The assortment included 44 cubic composite weights made of lead cores encased in bronze, with a small, tripartite projection on top (Fig. 9; Plate 5—p. 65).¹³ Lead-bronze composite weights are not uncommon, and cubic metal weights in form are typical in Phoenicia.¹⁴ Several Phoenician dome-shaped balance weights from the East show similar top projections to the cubic type from the shipwreck, except they are much larger and have been described as handles.¹⁵

The recovered weights are exciting, since Phoenician weight system(s) are not particularly well understood due to the limited number and sizes of known weight sets and the small quantity of meaningfully marked weights.¹⁶ The cube weights probably

represent more than one set, since there are multiple pan weights of the same denomination. However, the pieces have lost some or all of their outer bronze casing, and many are missing much of their lead core as well. The original volume—and thus mass—of each weight will have to be reconstructed accurately before a definitive metrological analysis can be made.

The team recovered six stone rods similar to one found in 2008, except that two of them are only about two-thirds the length of the others (Fig. 10).¹⁷ The type is generally cylindrical, but its diameter tapers slightly towards each end; it is finely turned from dull gray-green stone and has beveled ends. A second type that came to light early in the excavation is slightly longer and much larger in diameter, has simple rounded ends, and is cruder in appearance, although it seems to be the same type of stone. It closely resembles whetstones from Luristan, in western Iran, where a rich metalworking tradition flourished from the turn of the millennium to the seventh century B.C.E.¹⁸ The slimmer types from the shipwreck find a good parallel in a late seventh-century B.C.E. tomb in the necropolis at La Joya, near Huelva, in southwestern Spain.¹⁹ These pieces may in fact be burnishing stones used in jewelry making, rather than whetstones for sharpening metal implements (like the larger type). If so, they could link the shipwreck to Phoenician jewelry workshops known to have operated within indigenous centers in the Alicante region just north of Bajo de la Campana.²⁰

As was the case in 2010, the 2011 season saw the recovery of an intriguing assortment of worked pieces of wood and metal, although the fragmentary nature of most of these has so far precluded their identification. Materials from the ship's hold include many small twigs and larger branch fragments of the



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FIG 3
Dipper juglet recovered from the crevice. July 2011 (N. Puckett).

FIG 4
Tiny juglet recovered from the upper portion of the cave. August 2011 (J. Guillén Medina).

FIG 5
Phoenician oil lamp with two nozzles. July 2011 (J. Guillén Medina).

FIG 6
Ceramic bottle for perfumed oil. August 2011 (J. Guillén Medina).

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FIG 7
Arianna Villani excavates around a large tripod bowl. July 2011 (S.H. Snowden).

FIG 8
Simon Claeys holds a handful of galena. July 2011 (S.H. Snowden).

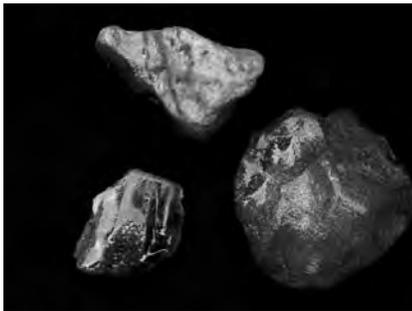


FIG 9
Detail of the top feature of one of the cubic pan-balance weights. August 2011 (J. Guillén Medina).

FIG 10
The two smaller burnishing stones. August 2011 (S.H. Snowden).

FIG 11
Three lumps of raw amber. August 2011 (S.H. Snowden).

brushwood dunnage used to pack the stowed cargo and protect the hull, as well as some 300 large, egg-shaped ballast stones. Finally, foodstuffs on board, whether merchandise or provisions for the crew, are represented by pine nuts, pinecone scales, almonds, and olive and fruit pits.

Luxury Goods

Previous finds have already established that the ship was carrying a second cargo of luxury or prestige objects, mostly singular pieces. Every campaign since 2007 has produced double-ended combs, each carved from a single piece of boxwood (*Buxus sp.*) and decorated with simple, incised lines within the central field.²¹ Several more were recovered in 2011, and the total consignment now comprises more than a dozen combs.²²

Another repeat find is represented by three small lumps of raw amber (the ancient *electrum*) towards the south side of the site (Fig. 11). These are the only such finds since the initial site survey in 2007, which produced two similar nodules. Chemical analysis of one of those pieces determined that the amber comes from the Baltic region of northern Europe, an area exploited since pre-history for its fossilized tree resin.²³ Amber was a popular material for making beads and for inlay in jewelry and carved ivory.²⁴

Two fragmentary ivory knife or dagger handles were added to the inventory, these from the bottom portions of the crevice, while a similar, more complete example came to light in 2009 (Fig. 12).²⁵ The handles have a simple, but elegant, curved shape with a rounded and expanded pommel. On the latter example are preserved seven rivets centrally aligned along the length of the slot where the blade tang was fastened. The slot runs half the length of the handle and extends across its full width, being open along both edges. Knives such as these are relatively common in the western Mediterranean from the latter half

of the eighth century until the sixth century B.C.E. They had prestige significance beyond mere practical usage or the intrinsic value of the ivory and metal from which they were fashioned. They represented the social elite as evidenced by their depiction in Eastern art as symbols of power and authority worn (often in pairs) by kings, supernatural beings,²⁶ and important court officials.

The upper portion of the crevice yielded another new item to the excavation collection, a small pin carved from antler (Fig. 13). It was found in close proximity to two oil bottles and has a thin, flat shape with two holes through its blunt end. Similar pins of bone have been found on several Roman period shipwrecks, including the so-called San Ferreol wreck located close by, off the beach of La Manga del Mar Menor, where the expedition house is located.²⁷ They have been interpreted as clothespins, hairpins, and even needles (when they are perforated), although the size, shape, and double holes in the Bajo de la Campana example make the latter identification less likely. The pin could be a cargo item or, alternatively, the personal possession of someone onboard the ship, but no other such property has come to light.

A particularly intriguing find is a long and slender wooden handle with a cylindrical, curvilinear shape (Fig. 14). One end is flared and has a central hole drilled into it. The piece may be the handle of a wisp or fan, but further investigation is required to establish a firm identification. Fans and flyswatters, and related parasols and standards, were common symbols of royalty and prestige in Egypt and the Near East, and this object may have had similar connotations.

The last group of finds consists of more exotic pieces, beginning with a carved ivory ring base (Fig. 15). It stands almost 3 cm high and has an outer diameter of about 8.5 cm. The base has a spool shape, with

symmetrical, outward flaring rim and base, and a raised ridge running around its center. A circular, blue-glass disc with a similar profile from the Late Bronze Age Uluburun shipwreck has been identified as the base for an ostrich eggshell.²⁸ The Bajo de la Campana piece may have served the same purpose, as several fragments of eggshell—presumably ostrich—were recovered in 2011.

The Phoenicians revived the use of ostrich eggshells as objects of art and ritual in the eighth century B.C.E., and spread it across the Mediterranean to their colonies and the local cultures they encountered. Ostrich eggs have appeared on sites dating from the eighth to the second century B.C.E., but are concentrated in the seventh and sixth centuries. Some have been found in habitation contexts, but the vast majority by far come from burial deposits.

In Iberia, finds of whole eggshells and fragments are distributed across the southern and eastern regions, in both Phoenician and indigenous contexts.²⁹ The Phoenician/Punic necropolis of Villaricos, in southeastern Spain, has produced well over 700 examples, representing the largest collection of these objects anywhere in the Mediterranean.³⁰ Ceramic bases for ostrich eggshells, with shapes similar to the ivory ring base from the shipwreck, have been found in graves along with the eggshells.³¹

Several pieces of alabaster jars also were among the 2011 finds. Alabaster jars of various types have been found at Sidon, in Phoenicia proper, and at other sites in the East, as well as in Etruria and at Carthage.³² Some 50 jars and 20 alabaster fragments, dated to the seventh century B.C.E., have been recovered from sites in the southern Iberian Peninsula and on Ibiza.³³ They were highly prized, and all but a few fragments were found as graves goods, wherein they served as cremation urns in high-status burials.³⁴ Many of these

jars are original Egyptian pieces and some have hieroglyphic inscriptions.³⁵

Finally, the expedition team recovered several pieces of a bronze cauldron or other vessel, and the upper portions of two bronze stands for incense burners, or *thymiateria* (Fig. 16).³⁶ The latter are of Cypriot type, while other examples have been found in Phoenicia and Northern Syria, the Aegean, Etruria, and on Malta, Sardinia, and the Iberian Peninsula.³⁷ Their importance is evident from the inclusion of two examples among the grave furnishings of Tabnit, a sixth-century B.C.E. Phoenician king of Sidon.³⁸ The pieces were manufactured from the end of the eighth to the beginning of the fifth century B.C.E., and those from Sardinia and Iberia are some of the earliest, assigned mainly to the seventh century.³⁹ At least three similar examples have been recovered from sites along the Guadalquivir River valley in south-central Spain. None of these, however, is particularly well provenanced, so the Bajo de la Campana examples will prove important for better understanding the chronology and production locations of these objects.⁴⁰

Discussion

Many of the objects raised in 2011 can be added to an impressive assortment of prestige goods that the ship was transporting, which include a limestone pedestal, bronze and boxwood furniture pieces, a bronze arm-shaped fixture, additional oil bottles, combs, and a dagger, along with wine and perhaps olive oil carried in amphoras.⁴¹ Bronze furnishings, eggshell and alabaster vessels, fine wine, and perfumed oils proclaimed the affluence and social standing of their owners when alive, and served

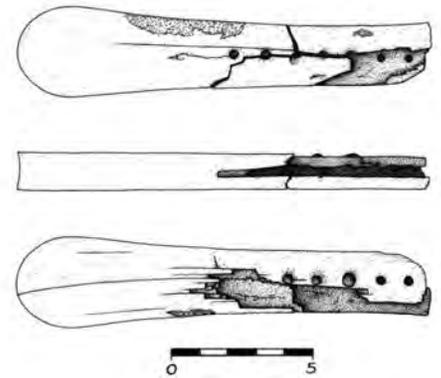


FIG 12
Ivory dagger-handle
raised in 2009. March 2011
(M.S. Crespo Ros).



FIG 13
Antler pin. August 2011
(J. Guillén Medina).

FIG 14
Wooden handle? September
2011 (M.S. Crespo Ros).

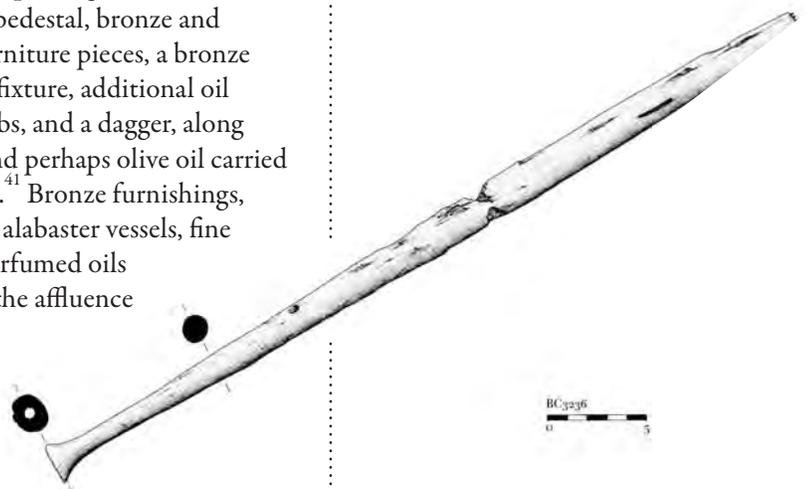




FIG 15
Ivory ring base for an
ostrich eggshell. July 2011
(S.H. Snowden).

them in death as ritual equipment, grave goods, and cinerary urns, confirming in perpetuity their elevated status. Moreover, trappings such as the ceremonial stave, fan, and daggers symbolized rank and power, particularly through their connection to ancient Eastern traditions. The families of such elites would have cherished these items and passed them on to their descendants as heirlooms. Indeed, the Egyptian alabaster vases adorned with hieroglyphs have been interpreted as heirloom possessions brought west by aristocratic Phoenician colonists and handed down across generations.⁴² Similar practices have been recognized with *thymiateria*;⁴³ the lineage and antiquity of these objects enhanced their prestige and, consequently, that of their owners.⁴⁴

During the so-called Orientalizing period, from the eighth to the sixth century B.C.E., Phoenician demand for raw materials sparked an economic boom for the indigenous inhabitants of the Iberian peninsula that led to profound social and cultural transformations. Indigenous societies assimilated Phoenician practices and came to prize such items as status objects and use them as class delineators.⁴⁵ This can be seen in their personal adornment, social practices, and burial customs, predominantly via the cultural materials they left behind—largely in tombs. The consignment of luxurious goods from the Bajo de la Campana shipwreck represents a collection of quintessential orientaling objects—oil bottles, tripod bowls, amphoras, alabaster jars, and fine works of wood, ivory, and bronze—that is nearly replicated in various tomb assemblages in Iberia, from both indigenous and Phoenician necropoleis.⁴⁶

The ship's cargo of raw materials may represent a two-fold venture. While raw elephant ivory could be viewed as a luxury commodity, it is probably better understood as

raw material on its way to a colonial workshop, along with supplies of raw metals and ores, the latter probably for the cupellation of silver in a region where lead was inaccessible.⁴⁷ Whereas the amount of ivory would seem considerable, the total weight of metals (less than a quarter ton) is rather modest, and could represent an order from a specific workshop rather than bulk supply.⁴⁸

As for the pottery cargo, preliminary inspection of some pieces indicates a production zone along the southern coast of Andalusia.⁴⁹ Certainly during this time, the repertoire of potteries in settlements like Cerro del Villar included all of the ceramic types found at Bajo de la Campana, save perhaps for the few eastern imports.⁵⁰ The region reached the height of its economic prosperity in the seventh century B.C.E., with settlements evolving into specialized centers for production and export of agricultural and fish products, pottery, purple dye, oil, wine, and unguents.⁵¹ The metals trade also flourished here, thanks to the opportune location of settlements like Morro de Mezquitilla and Toscanos that provided convenient access to the mining regions of the interior.⁵²

Just to the north of Bajo de la Campana was another area surging with economic and industrial activity. The Phoenician colony of La Fonteta, situated at the mouth of the Segura River at Guadamar, had active iron, copper, and bronze working industries, and silver and lead production as well.⁵³ The archaeological record of the region attests to Phoenician industrial enclaves in nearby indigenous townships, such as at Saladares and Peña Negra, that produced ceramics and exotic jewelry.⁵⁴ And although pottery was being produced locally by the end of the seventh century, the area maintained a continuous import of assorted ceramics from workshops along the southern coast.⁵⁵

This was also true for the young colony at Sa Caleta on Ibiza, which

probably was inhabited between the final third of the seventh century and the very early sixth century B.C.E., after which the colonists abandoned the site for another to the northeast, on the Bay of Ibiza.⁵⁶ All the wheel-made pottery found at Sa Caleta is imported from the south coast of Andalusia, and the types represented are typical of this production and almost identical to those in the shipwreck assemblage—transport amphoras, carinated bowls, lamps with two nozzles, plates, globular oil bottles, and tripods.⁵⁷ Also present are ovoid amphoras from the region encompassing Carthage, Sicily, and Sardinia; again like those on the ship.⁵⁸ Besides the ceramics, excavators found large quantities of galena scattered through many rooms and outdoors all across the settlement, as well as bronze and iron knives.⁵⁹ It would appear that the colonists at Sa Caleta were importing pottery, wine, and lead ore (and possibly other scrap metal), which they smelted into lead for resale in ingot form to areas further east.⁶⁰

Archaeological finds of transport amphoras from numerous excavations in the northeast suggest that trade in that region was largely focused on agricultural products, including wine, olives and olive oil, fish products, and salted meats, rather than on luxury goods.⁶¹ Nevertheless, ceramic tablewares and other dishes (oil bottles, tripod bowls, red-glazed plates and carinated bowls) do appear in necropoleis in the region, as do more prestigious objects such as a *chandelier* and decorated ostrich eggshells.⁶²

All of these products could have come from the southern colonies, perhaps via La Fonteta. What emerges is an eastern Iberian circulation of commodities that linked southern Andalusia to the east coast—Ibiza included—and northeastern corner of the peninsula. Southern seaports and, in the east, La Fonteta or Ibiza would have served as nodal points for material exchanges with Phoenician

colonies in the far west (Gadir), North Africa, and the central Mediterranean. It would appear that the Bajo de la Campana ship was engaged in this flow of goods when it sank. It probably originated at a southern emporium with a cargo of luxury goods for trade in the environs of La Fonteta, and with ivory and other materials perhaps for workshops in the same vicinity. The ore and pottery carried on board may have been destined for Sa Caleta, from where the ship was meant to head further north. For this final leg of its voyage, the ship may have been transporting some type of perishable bulk commodity, such as foodstuffs or cloth. Not only would this be consistent with known agricultural production in the south, but it would also help explain the low tonnage of the combined cargo recovered by excavation. However, beside several thousand pine nuts and a handful of other nuts and fruit pits, there is no other material evidence for the presence of any such payload. Given the site conditions and turbulent post-depositional history of the wreck, this is not too surprising.

Work continues on the identification and characterization of the myriad archaeological material from the shipwreck. We expect the analytical data and other results generated will provide answers to these questions and shed new light on this dynamic time in Spain's Phoenician history.

*In memory of Claude Duthuit—
friend, mentor, benefactor.*

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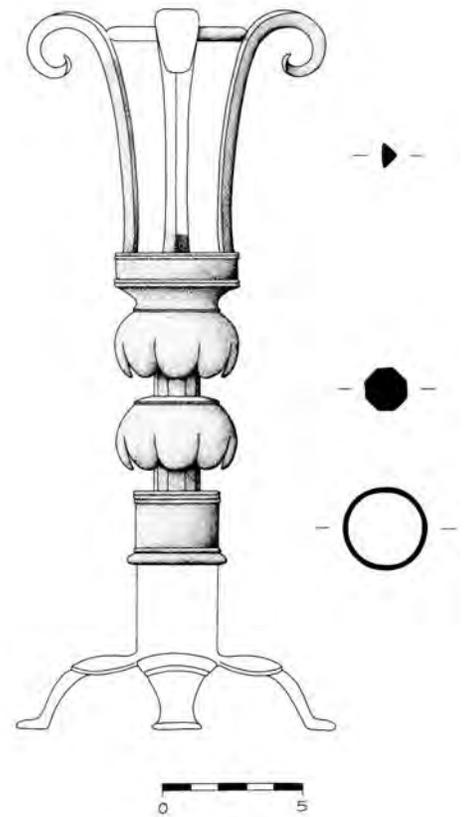


FIG 16
One of two *thymiateria*
stands recovered from
the wreck. August 2011
(M.S. Crespo Ros).

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Notes

* The excavation was officially named for Claude and Barbara Duthuit in 2011, after Claude's untimely passing, to honor their primary sponsorship of the project and Claude's pioneering and longtime involvement in INA. For more on Claude's remarkable life, see George Bass' tribute article in the Spring/Summer 2011 issue of the *INA Quarterly* (Bass 2011).

¹ Más García 1985a, 279–301; Roldán Bernal et al. 1995.

² Polzer and Pinedo 2007, 2008, 2009, 2011; Polzer 2011.

³ See Polzer and Pinedo 2008, 6 fig. 2 for a plan of the site.

⁴ Several of these came to light in the 2009 and 2010 campaigns; see Polzer and Pinedo 2009, 5–6, fig. 5.

⁵ López Malax-Echeverría 2006, 77–9 nos. 3, 5, and 8.

⁶ Ramón Torres 2002, 133, 135 fig. 4.1 (Sa Caleta) and 136, 145 fig. 9.1 (Puig des Molins).

⁷ Aubet 2001, 288; Maaß-Lindemann 1999, 130; Culican 1970, 6.

⁸ Buchholz 1963; Culican 1970, 11; López Malax-Echeverría 2006, 104.

⁹ See Culican 1970, 11, 14–6; Maaß-Lindemann 1985; Vives-Ferrándiz Sánchez 2007; and Garcia i Rubert and Gracia Alonso 2011 for sites and associated bibliographies.

¹⁰ Culican 1970, 15–6.

¹¹ For examples, see Culican 1982, figs. 3–7, 9.

¹² Seven tusks bear Phoenician votive inscriptions while another three are marked in some way.

¹³ Sixteen of these were found in 2010.

¹⁴ Kletter 1998, 61.

¹⁵ Elayi and Elayi 1997, 74 and pl. VI, nos. 122 and 124, 77 and pl. VIII, no. 134.

¹⁶ Kletter 1994, 1998, 61, 122–124. See Kroll 2008, 41 for a summary of the various Phoenician mass standards.

¹⁷ Two of the stone rods are broken. See Polzer and Pinedo 2008, 9 fig. 6 for the earlier find.

¹⁸ Moorey 1974, pl. IV, A–C; Curtis

1990, 28, 29 fig. 34.

¹⁹ Garrido Roiz and Orta García 1978, 140 fig. 88, 143, pls. LXXX.2 and XCVII.1.

²⁰ González Prats 1986; Aubet 2001, 340.

²¹ Polzer and Pinedo 2011, 88; wood species identification by Yolanda Carrión.

²² The poor and fragmentary preservation of the majority of these pieces makes establishing an exact count impossible.

²³ Amber analysis by Curt Beck and Edith Stout, Amber Research Laboratory, Vassar College.

²⁴ Higgins 1980, 35.

²⁵ Polzer and Pinedo 2009, 6–7, fig. 6; Polzer and Pinedo 2011, 88.

²⁶ See, e.g., the carved ivory deity from Temple VII at Bogazköy (Hittite, 14th–13th century B.C.) (Neve 1983, 447 fig. 22); the limestone stele of Baal (Ugarit, Late Bronze Age) (Yon 1991); and especially Assyrian bas-reliefs, such as those from the North-West Palace of Ashurnasirpal II (Nimrud, 9th century B.C.) (Reade 1999).

²⁷ Más García 1985b; and see Joncheray 1975, photo 8 (upper) for a pin from the Chrétienne C shipwreck that has a similar shape as the Bajo de la Campana example.

²⁸ Pulak 2008, 294, 324–5, no. 194b. Rather than a ring, the glass base is solid throughout, although the thin center is worn through.

²⁹ San Nicolás Pedraz 1975, 77 pl. I; Pellicer Catalán 2007, 65.

³⁰ Astruc 1951; Pellicer Catalán 2007, 65.

³¹ San Nicolás Pedraz 1975, 96, 96 pl. VIII.

³² See López Castro 2001–2002, 79 fig. 3 for map showing the find locations.

³³ López Castro 2006, 78 and 80 fig. 4 for the distribution map; see also, e.g., Pellicer Catalán 2002, 65–70.

³⁴ Lipinski 1984, 126–7; López Castro 2001–2002; López Castro 2006, 78, 84.

³⁵ López Castro 2001–2002, 78–79, 81 fig. 5; see also Gamer-Wallert 1973; Padró 1980–1985, 1984.

³⁶ The bronze vessel fragments include a flanged handle loop with rivets, and possibly part of a rim.

³⁷ See Jiménez Ávila 2002, 171–3, 178 fig. 122 and included bibliography for the individual finds.

³⁸ Hamdi and Reinach 1892, 90 fig. 35.

³⁹ Jiménez Ávila 2002, 173–4.

⁴⁰ Jiménez Ávila 2002, 174.

⁴¹ Polzer and Pinedo 2008, 8–9, fig. 5 for the pedestal; Polzer and Pinedo 2009, 6 figs. 7–8, 7 figs. 9–10 for the furniture elements; and Polzer and Pinedo 2009, 8 fig. 11 for the bronze arm fixture.

⁴² López Castro 2006, 84.

⁴³ Jiménez Ávila 2002, 174.

⁴⁴ Ampolo 1984, 471–3; López Castro 2006, 84. Some of the jars were repaired (Molina Fajardo and Padró 1983, 45), and in other cases, even mere fragments of alabaster jars were deposited with the dead (both Phoenician and indigenous), attesting to the great value placed on these objects (López Castro 2001–2002, 147).

⁴⁵ Torres Ortiz 1999, 155–6; Aubet Semmler 2002.

⁴⁶ See, e.g., the grave goods from La Joya (Garrido Roiz and Orta García 1978), which include a votive ivory casket and ivory support frame with bronze fittings and silver hinges (106–10, figs. 65–7, pls. LXXI–LXXII), an amber bead (44 fig. 20.3, 45, pl. XXVI.2), burnishing stones (140 fig. 88, 141 fig. 89, 143, pls. LXXX.2, XCVII.1, XC.2, XCVII.2), a mirror with ivory handle (91, 95, 100 fig. 60, pls. XLVII.1, XLVIII), a bronze *thymiaterion* (91, 97–9, figs. 57–9, pls. XXXVIII.2, LXI, LXII.1–2, LXIII), alabaster jars (110, 111 fig. 68), and similar Phoenician ceramic vessels.

⁴⁷ Craddock et al. 1987, 11 fig. 14.

⁴⁸ Assuming, of course, that the ship was a lone transporter and not part of a convoy, presumably others of which were carrying the greater portion of metals. See Ballard et al. 2002; Stager 2003; Stager 2005 for shipwreck evidence of merchant fleets.

⁴⁹ Mederos Martín and Ruiz Cabrero 2004, 266–7.

⁵⁰ Barceló 1995.

⁵¹ Niemeyer and Schubart 1969; Frankenstein 1979, 283; Maaß-Lindemann 1982; Molina Fajardo 1983; Schubart 2002; Aubet 2001, 315–7.

⁵² Keesmann et al. 1983; Niemeyer 1983; Schubart 2002, 7–9.

⁵³ Excavation produced metal scraps, slag, and bellow nozzles (*tuyeres*) and crucible fragments, along with galena nuggets and cupellation remains (González Prats and Ruiz Segura 1999, fig. 2; Renzi et al. 2009, 2584–7, figs. 2–3).

⁵⁴ González Prats 1986, 279–301; Aubet 2001, 340.

⁵⁵ González Prats 1986, 299.

⁵⁶ Ramón 2002, 148.

⁵⁷ Ramón 2002, 133–4, figs. 3.1, 4, 137 fig. 5, 139 fig. 6.

⁵⁸ Ramón 2002, 133 fig. 3.2, 134, 136, 146; Polzer and Pinedo 2009, 5.

⁵⁹ Ramón 2002, 134.

⁶⁰ Ramón 2002, 150, who argues that the colonists were not yet exploiting the local source of galena at s'Argentera, which is located on the opposite end of the island.

⁶¹ Luxury goods do not appear to any significant degree in the archaeological record until the mid-sixth century B.C. (García i Rubert and Gracia Alonso 2011, 38–9).

⁶² García i Rubert and Gracia Alonso 2011, 41, 45.



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Rebecca Ingram has been participating in archaeological research on ships and shipwrecks in Turkey since 2001 under the guidance of Dr. Cemal Pulak. She worked with the Institute of Nautical Archaeology team at the Theodosian Harbor excavations at Yenikapı in Istanbul between 2005 and 2008; she is writing her dissertation on the construction of ship YK11, a seventh-century merchantman found at the site.



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Michael Jones has participated in archaeological projects in Turkey, Spain, Portugal, and Massachusetts. In Turkey, he has worked under Cemal Pulak since 2003 on ships and shipwrecks dating from the Bronze Age to the Ottoman period. Between 2005 and 2008, Michael was part of Dr. Pulak's team at the Yenikapı excavations in Istanbul, assisting in the recovery of eight Byzantine shipwrecks. One of these ships, a merchantman dating to c. 900 C.E., is the topic of his dissertation.

The Yenikapı Project

CONTINUING RESEARCH ON TWO BYZANTINE SHIPWRECKS FROM CONSTANTINOPLE'S THEODOSIAN HARBOR

The post-excavation documentation of two Byzantine merchantmen from the Theodosian Harbor excavations at Yenikapı continued throughout 2011 at the Institute of Nautical Archaeology (INA)'s Bodrum Research Center in Bodrum, Turkey. These two ships, YK 11 (c. seventh century C.E.) and YK 14 (c. 900 C.E.), were excavated and dismantled in 2008 and 2007, respectively, at the Yenikapı excavation in Istanbul, Turkey. They are part of a group of eight shipwrecks from the Yenikapı site being studied by a team of archaeologists under the directorship of Dr. Cemal Pulak, associate professor at Texas A&M University and Vice President of INA.¹

The Theodosian Harbor, perhaps the largest harbor of the ancient city of Constantinople, was discovered near the district of Yenikapı in Istanbul during archaeological salvage excavations preceding the construction of a major transfer station between a new metro line and Istanbul's Marmaray Rail Tunnel, a submerged tunnel which will cross the Bosphorus Strait and connect the European and Asian sides of the city. Due to the sheer volume of archaeological finds, excavation by the Istanbul Archaeological Museums has continued non-stop since 2004, covering more than 58,000 m² of the urban center of Istanbul and yielding tens of thousands of artifacts dating from the Neolithic to late Ottoman periods. The largest collection of material is associated with the city's Theodosian Harbor, built on the southern shore of the Sea of Marmara (Propontis) in the late-fourth century C.E. In addition to harborworks built of stone, concrete, and wood, loose ship timbers, and ship's equipment, 36 Byzantine shipwrecks of fifth- to 11th-century

date have been found. The eight shipwrecks being studied by Dr. Pulak and his team date from the seventh to early-11th centuries C.E.

The timbers of shipwrecks YK 11 and YK 14 were transported to INA's Bodrum Research Center in 2008, where the post-excavation documentation of the shipwrecks was begun in the summer of 2009. This detailed documentation of the component pieces of both shipwrecks has been ongoing since June 2010, thanks in part to generous funding from INA. The goal of the 2011 season was to continue this year-round effort to produce an exhaustive record of each timber for a reconstruction and study of the vessels' design and use in antiquity, which will be presented by the authors as Ph.D. dissertations. The dormitory, staff, and laboratory facilities at INA's Bodrum Research Center have been essential for completing a long-term, comprehensive study of these important ship timbers on a relatively modest budget.

The post-excavation documentation of YK 11 and YK 14 follows the methodology established by Fred van Doorninck and J. Richard Steffy in their groundbreaking studies of Byzantine shipwrecks, especially the 11th-century shipwreck found at Serçe Limanı.² The documentation includes a written catalog, measurements, photographs, sketches, and 1:1 scale drawings which will be used to create plans and scale models of the surviving sections of the ships' hulls. These data will also serve as the basis for reconstructing parts of the hull and rig which have not survived.³ In 2011, many of the shipwrecks' several hundred timbers were fully documented; this process was finally completed in the summer of 2012.

Results of the 2011 Research Season

YK 11

Shipwreck YK 11 is a merchantman of seventh-century date (Fig. 1). The ship was found near the harbor's western extremity, the first area to suffer the effects of siltation from sediment deposited in the harbor by the Lycus River (Plate 6—p. 66). The shipwreck was found in a muddy layer full of debris and discarded objects such as broken pottery. Damage to timbers from woodboring shipworms (the *Teredo navalis* or teredo worm) suggests that the upper section of this ship was exposed for a period after sinking, although much of the lower hull was extremely well preserved by the anaerobic mud. Such exposure, combined with the significant repairs present on this hull, indicate that this ship was a worn-out vessel abandoned as a derelict, which slowly sank into a shallow, forgotten corner of the harbor. The ship was originally around 12 m in length and 4 m in beam. It was built primarily of Turkish pine (*Pinus brutia*) with a three-part keel of Turkey Oak (*Quercus cerris*).⁴ YK 11 was constructed using a combination of traditional ancient techniques and newer methods developed during the later Roman Empire. The hull was built with thin planks edge-fastened with unpegged mortise-and-tenon joints, similar to the contemporary seventh-century Yassiada ship excavated by INA on the Turkish coast near Bodrum between 1961 and 1964. Also like the seventh-century Yassiada ship, YK 11 was built with mortise-and-tenon joints only to the waterline; above the waterline, pre-erected frames were used to determine the shape of the upper portion of the hull, a shipbuilding technique which had been developed in the Late Roman period.⁵ The ship's framing followed an ancient pattern of alternating floors, which spanned the bottom of the hull, and paired half-frames, which

curved upward to support the sides of the vessel; this framing pattern had been in use in Mediterranean ship construction for about 1,000 years by the time YK 11 sank.

During 2011, post-excavation documentation of YK 11 focused on the framing of the ship, a task which required eight months to complete. Understanding the YK 11 framing proved to be particularly challenging due to the extensive repairs which had been made over the course of the vessel's lifetime. In addition to the documentation of framing, a large portion of the ship's keel, several stringers, and numerous UM (Unidentified Members, or loose ship timbers found on the wreck site) were documented during the 2011 season (Fig. 2). While some UM timbers are impossible to identify beyond a certain type of timber, the original positions on the ship of some UM timbers—particularly elements of framing—have been identified after thorough study and analysis of fastener patterns and have contributed important details regarding the construction of poorly preserved sections of the vessel.



FIG 1
Seventh-century shipwreck YK 11 prior to dismantling. July 2008 (O. Köyağasıoğlu).



YK 14

YK 14, a medium-sized cargo ship, was uncovered in the central area of the Yenikapı excavation in a stratigraphic layer of gray sand with shell and ceramic inclusions very different from the deposits in the western end of the harbor (Fig. 3, Plate 7–p. 66). The absence of damage from marine borers to nearly all of the surviving hull timbers indicates that it was buried quickly, probably in a storm which deposited a thick layer of sand onto the ship. Although the ship was found without a cargo (which may have been salvaged soon after its sinking), ceramic finds in the same stratigraphic layer as the shipwreck date the loss of the vessel to around 900 C.E. Almost 12 m of the ship was preserved; originally, the vessel was approximately 14 m in length and 4 m in beam. The ship was built primarily of Turkey Oak and Sessile Oak (*Quercus petraea*).⁶ Like YK 11, YK 14's lower hull planking was edge-joined, but with regularly-spaced wooden pegs called coaks rather than mortise-and-tenon joints, reflecting a change in Byzantine shipbuilding technology that occurred after the

seventh century. The upper part of the hull was built around pre-erected frames to which planks (without coaks) were fastened. Both ships are examples of some of the last stages of the ancient Mediterranean method of planking-first ship construction. By the 11th century, if not earlier, this tradition was supplanted by 'skeleton-first' shipbuilding methods, which have been used in wooden shipbuilding into modern times.

In 2011, the cataloging of the hull planking and keel timbers of YK 14 was completed. Many of the largest planking and keel timbers, which are up to 7 m in length, were removed intact from the wreck site. The documentation of these timbers, which was begun in 2009, was completed at INA's Bodrum Research Center between June and November of 2011 (Fig. 4). YK 14's large timbers are stored in a pair of 27-metric tonne (30-ton) capacity freshwater-filled timber storage tanks, with each large timber in a foam-lined crate. Detachable wooden molds were built to support curved pieces, which can be raised out of the water in the storage tanks for the drawing, photographing,

and cataloging of the timbers. The documentation of planking and keel timbers has provided important new details on the construction methods and repair of the ships, as well as the positions of frame timbers which were not preserved. In the colder winter months, the scale drawing and cataloging of the ship's 62 frames was begun in the Hethea Nye Wood Conservation Laboratory. The drawings of these timbers are particularly important for the reconstruction of the hull because the curvature of each frame provides the shape of the ship's hull in a specific area of the ship. Due to the excellent preservation of the ship's frames, these records can be used to produce a highly accurate reconstruction of much of the ship's hull.

Future Plans for the Yenikapı Ships

The cataloging phase of the study of YK 11 and 14 was completed in the summer of 2012; data collected during this phase will form the basis for the authors' dissertations on the analysis and reconstruction of



these well-preserved and historically significant vessels. Results from the study of shipwrecks YK 11 and YK 14, combined with those of other shipwrecks and artifacts from the Yenikapı site, promise to revolutionize our understanding of Byzantine seafaring technology and the role of maritime trade between the imperial capital of Constantinople and other areas of the Mediterranean in the early Middle Ages. Once our study of the shipwrecks is completed, the timbers of YK 11 and 14 will be conserved at INA's Bodrum Research Center in Polyethylene Glycol (PEG), a water-soluble wax used to conserve waterlogged archaeological wood, in a process that will take several years. After conservation, the timbers will be returned to Istanbul, where a planned archaeological museum will be devoted entirely to exhibiting the shipwrecks and artifacts from the Yenikapı site. A museum dedicated mainly to shipwreck finds in Turkey's largest city promises to showcase the wealth of Turkey's incredibly rich maritime heritage and expose the wider public to the methods and results of research in nautical

archaeology, a mission begun by George Bass and continued by many other INA researchers over the past 50 years.

Acknowledgments

We would like to thank Cemal Pulak, Vice President of the Institute of Nautical Archaeology (INA) at Texas A&M University, and the director of the INA excavation team at Yenikapı, for the opportunity first to work with him at the site as contract archaeologists and later for the incredible opportunity to research two of these shipwrecks for our dissertations under his guidance. We would also like to thank the Istanbul Archaeological Museums, especially directors Zeynep Kızıltan and İsmail Karamut, and assistant director Rahmi Asal; Yenikapı site archaeologists Sırrı Çölmekçi, Gülbahar Baran Çelik, Metin Gökçay, and Yaşar Anılır; as well as the other archaeologists and museum staff at the Yenikapı excavation. Special thanks are due to the archaeologists and staff who assisted in the initial excavation and in-situ recording of YK 11 and YK 14, especially Yasemin



CLOCKWISE FROM FACING PAGE

FIG 2 Rebecca Ingram preparing to photograph a UM timber from YK 11 outside the Hethea Nye Wood Conservation Laboratory at INA's Bodrum Research Center. Column drums from the Kızılburun shipwreck are visible in the background. March 2012 (M. Jones).

FIG 3 Late ninth- or early tenth-century shipwreck YK 14 during excavation. April 2007 (M. Jones).

FIG 4 Michael Jones cataloging the main keel timber of YK 14 in the freshwater storage tanks at INA's Bodrum Research Center. September 2011 (R. Ingram).

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Notes

- ¹ Pulak 2007; Ingram and Jones 2011.
- ² Bass et al. 2004, 73–169.
- ³ A more detailed overview of the post-excavation documentation may be found in Ingram and Jones 2011, 11–3.
- ⁴ Wood identification was carried out by Nili Lipshitz of the Institute of Archaeology, The Botanical Laboratories, Tel Aviv University.
- ⁵ Bass and van Doorninck 1982, 55–6.
- ⁶ Lipshitz and Pulak 2009, 168.



Deborah Carlson, Ph.D.
President, INA

Dr. Carlson is a tenured Associate Professor at Texas A&M University holding the Sara W. and George O. Yamini Professorship in Nautical Archaeology. She became President of INA in March 2011. A classical archaeologist specializing in trade and seafaring in the ancient Mediterranean, Dr. Carlson earned an M.A. in Classical Archaeology from the University of Arizona, where she participated in terrestrial excavations in Greece and Italy. Her archaeological fieldwork has been funded by the Archaeological Institute of America, the American Philosophical Society, the Samuel H. Kress Foundation, and the American Research Institute in Turkey; she is a National Geographic Explorer and an Expeditions Council grantee.

Reluctant Stones from the Sea

THE FINAL SEASON ON THE COLUMN WRECK AT KIZILBURUN, TURKEY



During the month of June 2011 a small crew of one dozen divers and archaeologists, most of them chiseled veterans of past seasons on INA's Kızılburun column wreck excavation, returned to the site to recover the remaining six column drums and close the site permanently. Two years earlier, a larger team had successfully raised two (the largest and smallest) of the eight total column drums and the Doric column capital, which were transported to the Bodrum Museum of Underwater Archaeology where they stayed until March 2011, when they were moved to the courtyard of INA's Bodrum Research Center (Fig. 1). The sizeable goals and short duration of the final 2011 season at Kızılburun required a team with purpose, professionalism, and proven skills in efficiency and safety, and this group exceeded expectations in every category. The shorter season, however, still left plenty of time for surprises and adversity, for although we succeeded in raising all six drums only half of them came willingly.

In the interests of saving both time and money, we opted not to rebuild portions of the terrestrial base camp designed by Robin Piercy and Mehmet Çiftlikli which had served us so well since the inaugural excavation campaign in 2005. Instead, we would dive from and live aboard INA's 58-year old research vessel *Virazon* (Fig. 2) which, although equipped with bunks for eight, accommodated our team of 12 very comfortably. Apart from myself, the 2011 Kızılburun team (Fig. 3) included Project Director Dr. Donny Hamilton (Texas A&M University) and Turkish Co-Director Dr. Harun Özdaş (Dokuz Eylül University), *Virazon* captain Zafer Gül, INA engineer Murat Tilev, Dive Safety Officer John Littlefield (Texas A&M University), hyperbaric physicians Dr. Matthew Partrick (Southern Ocean Medical Center) and Dr. David Lambert (University of Pennsylvania Hospital), INA archaeologists Sheila Matthews and Orkan Köyağasıoğlu, and Kızılburun project veterans Dr. Kristine Trego (Bucknell University) and Marilyn Cassedy (Texas A&M University). Emre Savaş of the Bodrum Museum of Underwater Archaeology served as our 2011 Turkish commissioner and governmental representative.

Among the final tasks at the close of the 2009 excavation season was wrapping the six drums that remained on the seabed in a protective layer of polyester



ABOVE RIGHT

FIG 1

The two drums and capital raised in 2009 were transferred to the courtyard of INA's Bodrum Research Center in March 2011 (R. Ingram ©INA).

ABOVE

FIG 2

INA's research vessel *Virazon* was our work platform for the 2011 season at Kızılburun (M. Partrick ©INA).

FIG 3
The 2011 Kızılburun team (standing L to R): Sheila Matthews, Orkan Köyağasioğlu, Marilyn Cassedy, Zafer Gül, Debbie Carlson, Kris Trego, Donny Hamilton, Emre Savaş, Harun Özdaş (kneeling L to R): Murat Tilev, David Lambert. Not pictured: John Littlefield (J. Littlefield ©INA).



FIG 4
Drum 3 being flipped on the seabed in 2009 (D. Frey ©INA).



sheeting so as to minimize the inevitable accumulation of marine plants and animals. So upon our return to Kızılburun on June 1, 2011, we knew that one of our first assignments following the installation of the necessary underwater safety equipment would be to unwrap each like a giant, submerged, 7-ton marble birthday present. We also knew that each of the six drums would need to be flipped 180° so that they could be properly rigged for raising to the surface – we had already flipped each drum 180° on the seabed in 2009 in order to expose the cleaner, concretion-free bottom face. When the last six were hoisted from the bottom and loaded on a ship bound for Bodrum we wanted to be sure that they would be resting securely on the cleanest, flattest possible surface.

Within one week of our arrival on site, the safety equipment was in place, most of the drums were unwrapped, and we were ready to attempt the first flip, of Drum 3. The drum-flipping process depends on the strategic placement of a single lifting sling rigged in a choker hitch and set down low on the leading edge of the drum (Fig. 4); the working end of the sling is attached to either one or two 1,800 kg (4,000 lb) lift balloons, depending on the size and weight of the drum. If all goes well the buoyancy of the filled balloon(s) creates enough upward lift on the sling to roll the drum 180° onto its opposite face and the sling arrives at the surface moments later attached to the lift balloon(s). Unfortunately, that is not what happened to Drum 3, which came off the seabed at a provocative 120° angle but then became wedged in the sand with sling and balloon still attached (Fig. 5). When deflating the balloon did not cause the drum to budge, we reattached the



FIG 5
Sheila Matthews inspects the situation of Drum 3, wedged in the sand with sling and balloon still attached (D. Carlson ©INA).



sling and balloon to the edge buried in the sand in order to sweep the drum back into its original position. The first lesson we learned from Drum 3 is that it's well worth the time needed in advance of the flipping to remove sand from the drum's intended path in order to create a clear and impediment-free trajectory.

Drum 3 was flipped the next day but this too did not go as planned because the drum missed its mark and did not land on the crisscrossed lifting straps that lay waiting for it. As a result we decided it was wiser to secure the lifting straps to the exposed drum face before flipping it over onto the seabed. In other words, after working non-stop for over a week, we still had not successfully rigged a single column drum in preparation for raising. Undeterred, we moved on to Drum 6, attaching the two lifting straps onto the face of the drum before attempting to flip it. In the end Drum 6 was flipped successfully but in the process the lifting sling snagged a piece of concretion on the drum wall, which tore both the sling and one of the balloons that was attached to it (Fig. 6). Humbled but not discouraged, we set our sights on Drum 8 about the same time the weather worsened and we were forced to relocate *Virazon* in the shelter of a nearby cove. On the next day we yielded to Mother Nature and conceded a three-day break so that Turkish team members could return home to vote in the Parliamentary elections.

One advantage of the brief election hiatus was that it allowed team members returning to Bodrum to fetch a replacement 1,800 kg (4,000 lb) lift balloon from INA's Turkish headquarters. Unfortunately, when we resumed diving on 13 June, with just one week left before the arrival of the crane boat that would hoist the drums to the surface, we found that one of the three functioning lift balloons had a leak, so we were left with only two.

Furthermore, in our attempt to flip Drum 8, the lifting sling pulled the straps off the face of the drum, and the entire package arrived at the surface in a gnarled mess, while on the bottom the drum lifted up briefly and fell back down. We might have smelled defeat in the air had we not been so distracted by the sound of a ticking clock.

Fine tuning our procedure once again, we ensured that the lifting sling for flipping Drum 8 could not make contact with the straps secured to the face of the drum by rolling up the loose ends of those straps to keep them out of the way, thus preventing the lifting sling from pulling all the rigging off the drum in the process of the flip (Figs. 7 and 8). The tide turned on 14 June, two-thirds of the way into our very short season, with the successful flipping of Drum 8. Over the next two days, we flipped the remaining three drums (Drum 1, Drum 2, and Drum 5), our speed due in part to the fact that the rigging on Drum 1 became snagged on a concretion and never went to the surface, hence saving us the time and hassle of hauling all those straps and lines back down to the seabed one more time (Plate 8—p. 67)!

As a gentle reminder that the ancient Greeks were routinely punished by the Gods for exhibiting excessive pride or hubris, on 16 June the sea conditions worsened yet again, accompanied by thunder and lightning (especially unwelcome aboard a boat filled with diesel fuel, gasoline, and oxygen). Earlier that day, INA's HD video camera and Gates underwater housing inexplicably floated away from the decompression stop and after hours of searching, miraculously reappeared alongside *Virazon*. With the crane boat due to arrive in just a few days, we still had to rig the obstinate Drum 3. Of course, because we had already flipped Drum 3 once (but missed the rigging), it would have to be flipped twice in order to expose the clean face, rig that face, and then flip the drum onto the rigging in preparation



for hoisting. We accomplished this incredible feat by flipping Drum 3 twice in one day!

For the next two days we made final preparations to hoist more than 40 tons of ancient marble column parts that hadn't seen the light of day for 2,000 years. This meant shackling together the four ends of the two straps on each drum and attaching buoy markers to help the crew of the crane boat locate the six drums that lay scattered on the seabed 46 m (150 ft) below the surface. In the process we located and raised two lead anchor collars and an anchor stock, while several other stone stocks observed on the seabed almost certainly belong to vessels earlier than the column wreck.

June 20 began with the pre-dawn arrival of our long-awaited crane boat (Fig. 9), paradoxically named *19 Mayıs* (Turkish for 19 May, which marks the start of the Turkish War of Independence in 1919). Captain Eray informed us that they would be using a crane and not a winch, which meant that each drum might take as much as 30 minutes to reach the surface since each could only be lifted in increments as the crane was raised. We organized quickly into five buddy pairs and prepared for dives of 15 minutes. Each dive team would attach two lines from the crane boat to the single shackle holding the ends of the lifting straps (Fig. 10), and then send a small yellow lift balloon to the surface to signal that

FACING PAGE FROM TOP

FIG 6
Archaeological Director Deborah Carlson and Dive Safety Office John Littlefield inspect the torn rigging that came off of Drum 6 (D. Hamilton ©INA).

FIG 7
Drum 2 (K. Trego ©INA).

FIG 8
Marilyn Cassedy and Orkan Köyağasioğlu make the final inspection of Drum 1 in preparation for flipping (J. Littlefield ©INA).

LEFT

FIG 9
Virazon and *19 Mayıs* from the Kızılburun camp site (K.Trego ©INA).

RIGHT

FIG 10
John Littlefield shackles
the lifting lines to Drum 6
in preparation for
hoisting to the surface
(M. Cassedy ©INA).

FIG 11
Drum 8 is hoisted to the
surface aboard 19 Mayıs
(J. Littlefield ©INA).



lifting could begin; a second balloon would be held in reserve in the event of a problem, to signal that lifting must stop.

Unfortunately, the mechanical failures began almost immediately upon lifting Drum 5, when a hose ruptured and sprayed hydraulic fluid all over the crew and deck of *19 Mayıs*. With the crane now powerless, and the vessel not anchored, she began to drift with the current as Drum 5 dangled in the water column. We watched in agony for over an hour, with the ship being repositioned occasionally, before the necessary repairs were made and

Drum 5 was finally safely on deck. Drum 8 came up next without a hitch (Fig. 11), but Drum 3 seemed determined not to be bested in the degree-of-difficulty category. Sadly another mechanical failure—this time in the ship's generator—brought the lifting of Drum 3 to a dramatic halt and forced an excruciating delay of six hours while Captain Eray telephoned Izmir to find the necessary replacement part and a mechanic to install it.

Later that afternoon, with the arrival from Izmir of the necessary part and the mechanic, came Ibrahim



FIG 12
Project Director Donny Hamilton bids farewell to the drums (J. Littlefield ©INA).



FIG 13
The remains of the Kızılburun camp and an impromptu Turkish sign advertising free lumber (D. Carlson ©INA).

Eliböyük, representative of the Bodrum Museum of Underwater Archaeology, who would accompany the drums back to Bodrum. When the drum lifting resumed around 6 pm, our topnotch team was ready; diving back-to-back the three remaining teams rigged Drums 1, 2, and 6; the last dive team, comprised of INA veteran archaeologists Sheila Matthews and Orkan Köyağasıoğlu, surfaced just as the sun was setting. Before the day was over we managed to organize a group photo on the deck of *19 Mayıs* (Plate 9—p. 67)—just in time to bid farewell to the last six column drums from Kızılburun (Fig. 12).

There was little on-site work left for our small but superlative team in the days that followed, as most of the datum towers, airlift pipes, tools, hoses, and usable lumber had been sent back to Bodrum aboard *19 Mayıs*. We raised the phone booth dome and spare safety tanks from the seabed for the last time since initiating the excavation six years earlier. We dismantled the fragmentary camp buildings and declared the remnants publicly available for the taking (Fig. 13). The six column drums traveled overnight to Bodrum and were relocated by truck to the courtyard of INA's Bodrum

Research Center, where they joined the two drums and capital raised in 2009 (Plate 10–p. 66-67). Their residence in Bodrum is temporary, however, pending an official decision about their final destination. Until that decision is made we will spend as much time as possible acquainting ourselves with their features and attempting to unravel the peculiar history of the nine majestic marble blocks from Kızılburun.

Acknowledgments

It is with profound gratification, gratitude, and sadness that I write this final excavation report for *The INA Annual*. This project could not have happened without the financial and logistical support of the Institute of Nautical Archaeology, the Center for Maritime Archaeology and Conservation, and the College of Liberal Arts at Texas A&M University; the National Geographic Society, the Samuel H. Kress Foundation, Spiegel Television, the International Catacomb Society, the American Philosophical Society, LiftAll Inc., and Subsalve, Inc. Among the numerous private donors who lent their support to this project, the generosity of Mr. David Koch was unparalleled. I am and will forever remain profoundly grateful to each and every individual participant who donated his or her time, sweat, patience, hard work, good humor and unanimity to this project over the course of six years (2005–2011) including each and every staff member of INA's Bodrum Research Center. For now, I look forward to the discoveries that await my own research, undertaken in collaboration with French and Turkish scholars working at the Temple of Apollo at Claros and funded by a grant from the Partner University Fund and Andrew W. Mellon Foundation, courtesy of the French American Cultural Exchange.

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Ms. Campana received her M.A. from Texas A&M University's Nautical Program and her B.A. in Archaeology, History, and Classics from the Libera Università degli Studi in Urbino (Italy). Since joining the Nautical Archaeology Program in 2006, she has worked with Dr. Filipe Castro as a research assistant in the J. Richard Steffy Ship Reconstruction Laboratory, and since 2009 has been assisting Dr. Cemal Pulak with various research projects in the Old World Laboratory.

FIG 1
The State Archive of Venice
on a sunny morning



In the Shadow of La Repubblica Serenissima

NEW DISCOVERIES FROM ARCHIVAL RESEARCH IN VENICE

Quis unquam orbicularem illam ac plane perfectam eruditionem...feliciter imbibit?
G.B. Egnatio, *De exemplis* (1554), iii

“Who has ever been happier than I to be immersed in that completely perfect erudition?” This introduction of *De exemplis* (1554) by the Venetian humanist Giovanbattista Egnatio (1478–1553) well describes my enthusiasm every time I set foot in Venice at the beginning of the summer. Sitting in silence inside the Archives, while the sun is shining on the sea, and reading for hours, musty manuscripts that were written by different hands over the course of centuries, may seem tedious. And yet, there is nothing more engaging to me than archival research, especially when investigating Venetian maritime history, shipbuilding practices, and naval architecture (Fig. 1).

The 2011 research season was particularly eventful and rich in discoveries. From June to August, I spent three months in the State Archives of Venice devoting my energy and time to the search for new manuscripts related to my Ph.D. dissertation entitled “The *Immortal* Fausto: The Life, Works, and Ships of the Venetian Humanist and Naval Architect Vettor Fausto (1490–1546).” Vettor Fausto attracted the attention of many naval historians, and earned a place of honor in the pantheon of Renaissance innovators with his construction of a unique *quinqueremis* (*quinquereme*, or five-cr).¹ The French historian Fernand Braudel noted, “Venice [...] designed its own ships, and it is not very prone to change them.”² The conception and construction of Fausto’s new vessel type—the *quinquereme*—therefore, deserves careful investigation with regard to its technical features.

Among my more exciting discoveries, is a biography of Vettor Fausto by an unknown author. This biography yields fresh information about Fausto’s life and literary activity, and is more complete than the one published by Paolo Ramusio in 1551.³ Prior to this discovery, we knew of only three works edited and published by Fausto: his Latin translation of the Aristotelian *Mechanics*, an edition of the comedies of the Roman playwright Terence, and an edition of some works by Cicero.⁴ However, this new biography provides a list of all Greek and Latin works published by Fausto during his lectureship at the School of Saint Mark. The significance of this discovery lies in the fact that, during the Renaissance, authors usually dedicated their printed books to their patron, and Fausto’s literary works are no different. The dedications written by Fausto in the preface of his books reveal new details about his life and solve, once and for all, the vexing question about his date of birth. Ennio Concina, following Degli Agostini, notes that Fausto was born “at the beginning of 1480,”⁵ whereas Francesca Piovan suggests that Fausto’s birthdate should be placed slightly later.⁶ One of the editions printed by Fausto indicates, however, that he was born in 1480. This information is confirmed by additional archival material related to the School of Saint Mark.

The documents so far collected from the Venetian Archives, and from other Italian and European libraries, enable us to trace the complete life of Fausto, disclosing new episodes about his career both as a humanist and as a naval architect.

Most importantly, we are now able to identify Fausto's political, social, and cultural connections in Venice. This is a primary consideration for my project, since these connections are pivotal in understanding how a newcomer like Vettor Fausto, a Venetian citizen of humble origins, was able, first, to be appointed a lecturer in Greek at the prestigious School of Saint Mark, and, later in life, to work as a master shipbuilder in the Arsenal, which was a closed environment not accessible to outsiders. Regrettably, Vettor Fausto's contribution to Venetian Humanism has been overlooked by philologists and historians of Italian literature.⁷ Thus, as part of my dissertation, I have undertaken a comprehensive study of all of Fausto's writings, both in Latin and Greek. The only known Greek poem written by Fausto is that published by Legrand, in his two-volume work *Bibliographie hellénique* (1885). Over the years, I have collected nearly a dozen Greek and Latin poems signed by Fausto. These works are scattered in various Italian and European archives, and libraries, and remain unpublished. I also discovered a letter that proves Fausto was a friend of Fra' Giocondo from Verona (1433–1515), the celebrated architect who, in 1500, left Venice after his appointment as royal architect in the French court of Louis XII. This friendship might have been the stimulus for Fausto to engage in his study of naval architecture.

An even more exciting discovery from the summer of 2011 is a new manuscript entitled "Vettor Fausto's Quinquereme" by an unspecified author. This document provides a comprehensive account of Fausto's vessel, and gives detailed instructions of how to build his *quinquereme*. Given the accuracy of the measurements recorded in these folios, and the completeness of the shipbuilding instructions, it is likely that the author of this manuscript witnessed the construction of Fausto's *quinquereme*, or perhaps the author of the document was Fausto himself. More importantly, this document is the only one among those that have surfaced to date, to explicitly note in its title that the recorded instructions pertain to Fausto's *quinquereme* (Fig. 2).

Another important discovery from 2011 that should not pass unmentioned is a document dated to the first half of the 16th century. This long manuscript discusses in detail the rowing style of light galleys, which was a source of heated debate among shipbuilders in the Venetian Arsenal at that time. Toward the mid-16th century, a new rowing style (*alla scaloccio*, "in the ladder way"), consisting of three men on the same bench pulling a single long oar, replaced the old rowing style *alla sensile*, "in the simple way," which had three men sitting on a single bench each pulling a separate oar. Who introduced this new style of rowing on Venetian galleys is not certain, and historians have been debating it for a long time. This seemingly unimportant innovation revolutionized the medieval Mediterranean galley into a modern war machine by allowing it to be built much larger, more durable, and, most importantly, suited for outfitting with heavy ordnance; earlier galleys could carry only a few small guns. This new document is an extremely significant discovery, since it reports that Vettor Fausto introduced the Venetians to the *alla scaloccio* manner of rowing! The

FIG 2
The so-called "galleass ship sheds."



earliest evidence for the introduction of the long and heavy *alla scaloccio* oar is to be found in a document dated to 30 July 1534, which discusses the dispatch of 60 long oars for a certain sea captain.⁸ A senatorial decree dated to 19 January 1542 asserted that “*Dominus* Vettor Fausto, who has been always faithful and helpful, and always purported to provide us with the benefit of his clever inventions that he made in the past and that are worthy of praise, since [Fausto] improved our galleys. In this present day, he devised a new system to arrange the crew of the galleys, so that both the rowers hired from the mainland and those from the Levant would be able to row easily.”⁹ It has been suggested that the *alla scaloccio* rowing system was introduced at a time when the shortage of trained and professional rowers, who are essential for rowing *alla sensile*, compelled the Venetian navy to press slaves and convicts (*forzati*) into service as rowers aboard galleys. The above document is cited also by the historian Alberto Tenenti, who explains that the term “rowers from the Levant” actually denotes convicts and slaves from Dalmatia.¹⁰ Fausto also referred to *le zurme di terra ferma*, “rowers from the mainland,” meaning that they were not trained rowers.

Over the years spent in the State Archives of Venice, I have established excellent working relationships with the archivists. In 2011, one of the archivists located a new manuscript with shipbuilding instructions to build a light galley. This significant document was given to me for study and publication. This certainly was an incredibly good stroke of luck that does not happen very often, and I was extremely grateful for this most valuable present. During my research in the Archives, I also discovered elsewhere, the original drawing depicting the light galley described in the new manuscript; the drawing was preserved in a folder different from that of the shipbuilding manuscript.

It is rare to be able to reunite with certainty, a drawing that has been stored separately from its original manuscript; and, indeed, on the day of my discovery there was a lot of excitement in the archive!

This past summer, I had the good fortune to be visited by Dr. Gregory Maslow and his wife Laurie, who are consummate travelers and have visited Venice many times, being avid connoisseurs of Venetian art, architecture, and history. Dr. Maslow, who recently became a director of the Institute of Nautical Archaeology, is exceptionally knowledgeable about Venetian maritime history. With the help of Guglielmo Zannelli, a former Admiral of the Venetian Navy, an expert on Venetian maritime history, and a good friend, we visited the Arsenal. Guglielmo kindly guided us into the secret world of the Arsenal, providing us with an excellent and most informative tour. We first visited the Old Arsenal, and then, the New and the Newest, and the shipsheds as well, including one shipshed still preserving its original roof. He later invited us to a lunch at the Navy Officers Club where we visited the only two surviving ovens used to make hard-tack (biscuits) for the crew of Venetian ships (Figs. 3 and 4).

Over the years, I have received several scholarships and grants in order to carry out my research in the archives of Venice and in other libraries. I wish to thank INA’s Board of Directors and Archaeological Committee for providing funding for my project since 2007. In particular, I am deeply grateful to INA’s new President Dr. Deborah Carlson, as well as Drs. Cemal Pulak and Shelley Wachsmann. Dr. Pulak deserves special thanks, for he not only agreed to serve as Chair of my dissertation committee, but also carefully and thoroughly read my M.A. thesis, and provided me with helpful insight, suggestions, and constant support. One of the important lessons I have learned working as a graduate



FIG 3
Former Admiral Guglielmo Zannelli with Dr. Gregory Maslow in the Naval Museum.

FIG 4
Dr. Gregory and Mrs. Laurie Maslow with former Admiral Guglielmo Zannelli in front of the Arsenal fountain built from the melted iron of dismissed cannons.

student assistant is: “The more you know, the more you realize how little you know!” Keeping in mind this wise Socratic teaching, I have been exposed to a wide variety of Dr. Pulak’s projects ranging from the Bronze Age to the Ottoman Turkish period, all of which have broadened my knowledge and challenged me in most unexpected ways. I am also very thankful to Dr. Filipe Castro for serving as Chair of my M.A. thesis committee and for his advice, time, and patience. Working in the Ship Reconstruction Laboratory as his assistant from 2007 to 2009, and helping students with their projects, was among my most challenging and rewarding experiences. I am most thankful to Dr. Robyn Woodward for her warm encouragement and financial support of my many trips to Italy. I thank also Dr. Gregory Maslow and his wife Mrs. Laurie Maslow for their enthusiasm in supporting my research and for the rewarding day we spent together in Venice. I am most grateful for the education and encouragement I have received from the entire Nautical Archaeology Program faculty at Texas A&M University, and for making my stay in the program a great experience that has enriched me in many ways, both as a scholar and as a human being. In many ways, the Nautical Archaeology Program is much more than my intellectual home; the professors and my fellow students have become my family in the United States.

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Notes

¹ Brief biographical information on Fausto's life appeared in the works by Degli Agostini (1752–1754, 2:448–72), Tiraboschi (1824, 7:1487–89), Casoni (1838, 2:307:401), Cosenza (1962, 2:1363–64), Lane (1965, 59–65), and Wilson (1988, 89–95). Recently, the entry "Vettore Fausto," edited by Francesca Piovan, was added to the prestigious *Dizionario Biografico degli Italiani* (1995, 45:398–401). The most authoritative and comprehensive account on the life of Fausto is, however, that of the distinguished historian Ennio Concina, *Navis: Humanism on the Sea* (1990). Concina also mentioned Fausto in other publications (1984, 99–125; 1988a, 228–45; 1988b, 159–65; 1987a, 23–28; 1987b, 387–405; 2006, 99–125). Aymard (1980, 3:302) wrongly identified Vettor Fausto with Fausto Venanzio da Sebenico, who is the author of the mechanical treatise titled *Machinae novae*.

² Braudel 1976, 1:311: Venezia [...] ha i suoi tipi di vascelli e non cambia volentieri. For a most helpful overview of the types of ships built in the Venetian Arsenal during the Middle Ages and the Renaissance, see Concina 1991b, 211–58.

³ Fausto, 1541. Paolo Ramusio wrote an introductory letter.

⁴ Fausto, 1511, 1511a, and 1517.

⁵ Degli Agostini 1754, 2:448; Concina 1990, 26; Piovan, 1995, 45:398–401.

⁶ Piovan 1995, 398.

⁷ Hodius and Jebb 1742, 32; Legrand 1885, 1:102–5 and 115; Lowry 1979, 54; and King 1986, 72.

⁸ ASVe, Patroni e Provveditori all'Arsenale, reg. 8, fol. 37v.

⁹ ASVe, Senato mar, reg. 26, fols. 160v–

161r: Invigilando Domino Vettor Fausto con ogni studio, et diligentia al beneficio delle cose nostre per la molta affitione, et fidelità soa verso de noi, oltre le altre cose ingeniose, et degne di laude dallui fatte per il passato di utilità grande nelle nostre galee, al presente ha escogitato un modo di acconciar talmente esse galee, che le zurme di terra ferma le potranno vogare commodamente come fanno quelle di levante.

¹⁰ Tenenti 1962, 91, n. 19.



John Pollack, M.Sc.
Project Director/INA

An INA Research Associate and independent Canadian researcher based in British Columbia, John is also a former President of the Underwater Archaeological Society of B.C., a fellow of three scientific exploration organizations, and an affiliate member of the B.C. Association of Professional Archaeologists. His predominant work has been in Jamaica and western Canada with expertise in “high-tech” mapping of foreshore and underwater sites, and sternwheeler construction and nomenclature.



Robyn Woodward, Ph.D.
Project Archaeologist
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Dr. Woodward holds her degrees from Simon Fraser (Ph.D.), Texas A&M University, University College, Cardiff, and Queen’s University in Kingston, Ontario. Her fields of research are underwater archaeology and maritime history. Aside from her work on the Yukon River Survey, Robyn also directs the excavation of Sevilla la Nueva in Jamaica. Professor Woodward is the AIA’s 2012/2013 McCann/Taggart Lecturer.

Beans, Beavers and Bustles

THE 2011 YUKON RIVER STEAMBOAT SURVEY

The rivers of northern Canada offer a short and unpredictable season for field work. The summer of 2011 was unusually wet, and the result was record water levels on the Yukon River. Accordingly, the Yukon River Steamboat Survey encountered difficult conditions, low visibility and fast-moving water during the three-week campaign in August 2011. While the first two phases of field work were conducted successfully as planned, river conditions forced the cancellation of the third phase: a detailed in-water assessment of the most famous steamboat accident on the Yukon River—the *Columbian* disaster. The remains of *Columbian*’s hull were located in 2010 after a three-year search, but the August 2011 conditions were dangerously similar to a 2008 flood that delayed work on the wreck of *Klondike 1* for a full two years. In addition to the high

water this year, there was a unique complication—a colony of beavers had buried *Columbian* in logs and mud.

Our field work, outreach, and publication efforts will be discussed in that order.

Field Work

The 2011 field work consisted of three separate phases located near Dawson City, downstream of Carmacks at Rink Rapids, and upstream of Carmacks at the Columbian Slough (Fig. 1; Plate 11–p. 68).

The prior six years of field work have generated data for two major papers on both the range of vessel designs used in the Yukon stern wheel steamboat fleet, and the factors related to their abandonment as the population of the area declined after the gold rush. During the first phase of the 2011 field season, Robyn Woodward and John Pollack worked out of Dawson City to



produce a manuscript for the abandonment paper, and to confirm conclusions related to the engineering and construction techniques employed on different classes of steamboats used on the river. Evenings were spent writing and refining observations, while days were spent at the old shipyard across the river at West Dawson, crawling through the remains of seven great steamboats (Fig. 2). In this manner the conclusions from the night before could be checked in the field the next day. Any disagreements or new ideas were debated while standing within the holds or on the decks of various ships, and a few missing measurements were obtained as well. We also spent many hours at the Dawson City Museum Archives.

While the abandonment paper was the primary objective for Phase One, a wonderful and unexpected discovery occurred at West Dawson. For years the Survey and our collaborators in Western Canada and the United States have sought evidence of vessels that incorporated an advanced hull design with bustles or skegs as sometimes seen on the aprons (e.g. raked sterns) of American western river steamboats. One known example is *Montana* on the Missouri River, documented by Corbin and Bradford in 2008. During our 2011 work at West Dawson, we removed the debris from the stern of the open hull of *Victorian*, to reveal three recessed elliptical “apron pockets” forward of the rudder stocks, protecting the leading edges of the three balanced rudders (Fig. 3). This stern design is also referred to as a “bustle.” *Victorian* was built by Mississippi pilot and shipbuilder John H. Todd at Esquimalt, British Columbia in 1898. Not only is its bustle stern unique in Canada, it is a more complex and sophisticated design than the structures described on the stern of



Montana. While the forward parts of *Victorian* were salvaged extensively after abandonment, the stern frames and planking, the bustles, and the associated rudders, tillers, transom and false transom are intact and *in situ*. The scribed layout marks of the shipwrights are still clearly discernible on the frames of the false transom.

This discovery will allow for a case study of the migration of shipbuilding technology from the Midwestern USA, onto the Missouri River, north to Saskatchewan, and finally to British Columbia and the Yukon, by the Todd

FACING PAGE

FIG 1
Location map for the Yukon. 2011 (J. Pollack).

ABOVE

FIG 2
The collapsed superstructures of *Schwatka*, *Seattle No. 3*, and *Julia B* in the old shipyard at West Dawson. 2011 (R. Woodward).

FIG 3
Robyn Woodward and the bustle stern of *Victorian*. 2011 (J. Pollack).



FIG 4
Robyn Woodward
excavating the stern
of *Casca*. 2011 (D. Reid).

FIG 5
Dawson prior to wrecking at
Rink Rapids fall 1926. (Yukon
Archives 5195 HC Barley
fonds ca 1901).

family of captains and shipbuilders who were also involved in the construction of *Montana*. Research into the history of the Todds and their Canadian-built vessels is ongoing.

The second phase of the 2011 field work involved a 100 km riverboat trip out of Carmacks to place a six-person team in a wilderness camp below Rink Rapids—a major hazard between Whitehorse and Dawson City and the scene of numerous steamboat wrecks. Sean Adams, Doug Davidge, Donnie Reid, Robyn Woodward and John Pollack accompanied Tim Dowd of the Yukon Government to this famous navigational obstacle. We quickly located the second hull of *Casca* (it had been rebuilt and rehulled before being lost at Rink Rapids).

The wreck of *Casca* is a foreshore site in a side channel on the western shore of the river below Rink Rapids. Overall length of the visible hull remains was 49.64 m, with the bow facing south into the current. The superstructure is entirely missing and the majority of the deck beams and main deck planking have been destroyed or heavily damaged by river ice. The port side of the vessel has been destroyed by ice above the turn of the bilge; however the floors and lower hull sheathing are intact and submerged in up to 1 m of water. The majority of the extant hull is buried under gravel and cobbles, except for the port side lower hull planking and floors which are located below water. The portion of the starboard side of the hull that is on the shore is covered by small willow trees up to 2.5 m tall.

Moving inland from the shore we encountered the starboard, solid longitudinal bulkheads as the hull is progressively more intact and three-dimensional. Deck beams and deck planking are *in situ* toward the starboard stern section of the vessel (Fig. 4). The engine cylinders were supported by trusses and held in tension by tie rods. A 6.1 m width of beam is preserved, and further explo-

ration revealed two additional solid keelsons. The 1.23 m long forged iron tillers are largely intact and the circular rudder posts, bearings and forged linkage arms remain affixed to the transom. We were unable to determine whether this was a three- or four-rudder system due to ice damage. All of the other machinery components from this vessel including the engines, boiler(s), paddlewheel shaft, capstan and fittings, are missing. A large scatter of siding planks and debris from the upper decks was found on the steep riverbank above the band of willows that borders the side channel.

The next day the team located a terrestrial site 1.5 km upstream of *Casca II* on the western shore of the river where abandoned ship components attest to a major salvage effort of a second vessel tentatively identified as *Dawson* (Fig. 5). The hull of this vessel has not been located and may lie submerged in fast-moving water immediately offshore of the salvage site. The salvage site itself is a scatter of 63 artifacts comprising mainly iron steam pipe located on the western side of the rapids. A dugway or horse trail cut through the riverbank suggests the salvaged material was moved onto land, sorted, and then moved either up or down river to a more protected site where it could be loaded onto barges.

The salvaged artifact scatter included 33 sections of 5.0 to 7.5 cm diameter steam pipe, a large section of double-riveted boiler shell, a hog chain plate, and a 3.04 m long by 0.74 m diameter steam drum associated with the boiler (Fig. 6). We also found a massive 1.06 m long horned cleat still attached to a small section of deck beams and main hull planking. Additionally the team located fragments of galvanized iron hull sheathing, a section of a high-pressure engine or steering cylinder, a clamp assembly for a boiler clean-out hatch, and miscellaneous wooden debris including a 2.20 by 0.59 m portion of a cylinder timber supporting what appears to be

an engine bed. The fragmentary nature of some of the large machinery and a dynamite box found near the remains of a landing stage (?) suggests explosives may have been used in the 1926-27 late salvage effort. An assessment report of the salvage site including a GPS map and a photographic inventory with measurements of all debris has been prepared for the Government of Yukon.

While most of the team combed the shore mapping the debris field, Doug Davidge ran a side-scan traverse through the shallow eddy immediately offshore of the salvage site. No evidence of a hull was found. We did not put a diver into the eddy due to the unseasonably high water, the proximity of the rapids, and low visibility. Any hull in this proximity to the rapids would have been buried quickly by gravel such that only the tops of the uppermost timbers and some tie rods might still be visible. In such a situation a downstream scour would be expected, but no such scour was seen on the scans.

The third phase of the 2011 project involved the same team moving 75 km upriver to the site of *Columbian* for what was anticipated as the major field component of the season. This famous shipwreck occurred in 1906 upstream of Carmacks, when three tons of blasting powder were ignited on the bow of the vessel en route to a mine, resulting in a number of fatalities. Heroic actions by the captain, engineer and crew prevented a larger loss of life (Fig. 7).

The hull was located by an INA team in August 2010, after several earlier attempts. At the time of the original find, the lower hull lay at the head of a side channel in less than a meter of low-velocity water. We expected similar conditions in 2011, and the research objectives were to prepare a complete total station map of the remains of the hull, and search for and map any debris fields at the grounding and salvage sites.

Arriving at the site, we found conditions had changed from 2010. High water, fast current, and a large accumulation of wood debris and silt now covered the wreck site. The debris accumulation was due to increased beaver activity and the expansion of a beaver lodge immediately downstream of the site. This obstacle has acted as an efficient trap for logs and floating debris.

A single diver was put into the water and he found the wreck buried under debris and mud. Visibility was 30 cm or less, with swift water and a log jam consisting of sharp, protruding beaver-cut logs (Fig. 8). This combination of factors made the site unworkable, and all further efforts were cancelled. Doug Davidge did side scan the main channel and the slough with a Hummingbird 1197. He located a 5 m long rectangular target and scour hole, mid-channel and immediately off the campsite on the eastern riverbank. Likely, the mid-channel current will prohibit any diving on this target.

With our Phase 3 plan deemed impossible, a disillusioned team returned to camp, and after a solid bean and steak dinner around the campfire we shared our diminished appreciation for our national symbol—the beaver. Yet again we had been reminded that nautical archaeology in northern Canada, no matter how well planned, was subject to the vagaries of a short season, an ever-changing climate, unpredictable river conditions, and in this case—overly industrious wildlife.

The best strategy for the *Columbian* site will be patience. The mass of debris now covering the wreckage may naturally clean itself out during the 2012 and 2013 spring floods. We can reassess the site in the fall of 2012 and make a decision at that time about organizing a second attempt to map and document this famous wreck and its associated debris fields, in late September 2013.



FIG 6
Boiler steam drum from *Dawson*. 2011 (D. Reid).

FIG 7
October 1906 aftermath of the explosion and fire on *Columbian* (Yukon Archives, Muirhead Collection).



FIG 8
The unexpected log jam
covering *Columbian*. 2011
(D. Reid).

Outreach and Publication

Two important developments have occurred related to outreach efforts for this project. Dr. Robyn Woodward has been awarded the McCann-Taggart Distinguished Lectureship for 2012-13. This endowed lectureship is sponsored by the Archaeological Institute of America (AIA) and is entirely dedicated to underwater archaeology. Robyn will be speaking about INA's Yukon project in late October 2012 at six AIA societies across the United States. Her stipends will be donated to INA-124 in support of the project and announcements of the lecture dates and venues will be featured on the INA website.

John Pollack was elected to the College of Fellows of the Royal Canadian Geographical Society (RCGS). He is working with an allied council, the Canadian Cooperative for Geographic Education (CCGE) to establish class modules concerning the Klondike Gold Rush and steamboat archaeology for middle and high schools across Canada. Other participants include Parks Canada and the other RCGS professionals and now that the project plan has recently been finalized, the CCGE is soliciting donors and grants for this large initiative.

Five reports and publications were written in 2011 for release in 2012. Lindsey Thomas' substantial M.A. thesis on *A.J. Goddard* was edited for publication in late March 2012. Additionally a popular booklet entitled *The Wreck of the A.J. Goddard: A Stern-wheeler from the Days of the Klondike Gold Rush* was written by Thomas, Davidge and Pollack also for release in March 2012. Both of these publication efforts were funded by the Government of Yukon.

In 2011 Nathan Richards and Sami Seeb invited Pollack and Woodward to submit a chapter on the Yukon stern wheelers for the Springer book, *The Archaeology of Watercraft Abandonment: Ships Graveyards and Forgotten*

Fleets. The chapter describes the history of the Gold Rush, the influence of railroads in the drainage, the policy and competitive factors involved in the decline of the fleet after 1900, and a numerical analysis of both the size and origins of the fleet and the nature of the losses suffered on the river and during transit to the drainage. The manuscript has been accepted and the book is scheduled for publication in late 2012.

Pollack, Woodward and Davidge produced a second and expanded revision of the illustrated catalogue entitled *A Catalogue of Historic Stern Wheel Steamboat Wrecks and Hulks in the Yukon*. This report is a site management tool directed toward archaeologists and managers of the Government of Yukon. The manuscript contains the specifications, operational histories, Borden Numbers, current status and publications associated with each of the 24 known sites.

Finally Pollack completed the mandatory annual permit (file) report to the Government of Yukon, on the field work conducted under the 2011 Class II permit.

The Future

The year 2012, will be an outreach, research and writing year focusing on the different styles and methods of construction used on the Yukon River stern wheel steamboats. In the fall of 2012, we plan to examine possibilities and, dependent upon the availability of funding, to continue field work in 2013.

The key phases will be:

- ▶ Location and preliminary documentation of the stern wheel steamboats *Glendora* and *Mona*, burned 27 March 1902 while frozen-in at Steamboat Slough opposite Dawson City.
- ▶ Conducting a detailed assessment of the complex stern of *Victorian* at West Dawson.
- ▶ Conducting a detailed assessment of *Columbian* upstream of Carcross,

water and debris conditions permitting.

Acknowledgments

We wish to thank the current and past INA presidents, the INA Board of Directors, and faculty of the Texas A&M University's Nautical Archaeology Program for their continued support in 2011.

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Piotr Bojakowski, Ph.D.
National Museum of Bermuda/INA

Originally from Poland, Piotr is an INA Research Associate and graduate of the Nautical Archaeology Program at Texas A&M University. He specializes in early modern and Atlantic shipbuilding and ship archaeology, hull reconstruction, maritime history, and preservation of artifacts recovered from underwater sites. He has participated in surveys and excavations in the Mediterranean and Northern Europe, North America, and Southeast Asia. Aside from *Warwick*, he co-directs the Western Ledge Reef Wreck Project which was a focus of his doctoral dissertation.



Katie Custer, Ph.D.
INA

Katie obtained her Ph.D. through the Nautical Archaeology Program at Texas A&M University, specializing in early modern Atlantic seafaring and shipbuilding traditions, ship construction and technology, and nautical archaeological methods and theory. Katie is co-director of the Western Ledge Reef Wreck Project and the *Warwick* Project. There have been three field seasons of the *Warwick* Project including a survey in 2008 and full scale excavations in 2010 and 2011.

Michael Gilbart Texas A&M University
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THE SECOND EXCAVATION SEASON OF

Warwick AN EARLY 17TH-CENTURY COMPANY SHIP AT BERMUDA

Since 2008, the National Museum of Bermuda (NMB), the Institute of Nautical Archaeology (INA), and the Center for Maritime Archaeology and Conservation (CMAC) at Texas A&M University have been investigating the wreck of the English galleon *Warwick*. Between 4 June and 22 July 2011, an international team of archaeologists and students conducted a second season of excavation. Dr. Piotr Bojakowski and Dr. Katie Custer were the project directors and primary investigators, while the project staff included Douglas Inglis, assistant director; Michael Gilbart, divemaster and safety officer; visiting scholars Dr. Kevin Crisman; Dr. Jonathan Adams; Dr. Kroum Batchvarov; as well as team members Daniel Scott, Maureen Merrigan, Rodrigo Torres, Susana Vallejos, Leah Crisman, James Davidson, Jason Paterniti, and numerous other Bermudian, American, and European volunteers (Plate 12–p. 69).

Introduction

On 20 October 1619, *Warwick* arrived at King's Anchorage in Castle Harbour, Bermuda (Fig. 1). Unlike the less accessible St. George's Harbour, Castle Harbour (previously known as Southampton Harbour) was considered a superior anchorage for large oceangoing ships in the early days of the settlement. The only opening in the defenses formed by a chain of small rocky islands and reinforced by a system of redoubts and forts was Castle Roads, a channel to the southeast by which vessels entered and left the bay.¹

The ship was a proud possession of Sir Robert Rich, the second Earl of Warwick, who was a major ship-owner, statesman, privateer, and investor in the Virginia and Somers Islands Companies (Fig. 2). In addition to passengers and cargo, *Warwick's* mission was to deliver Captain Nathaniel Butler, the newly

elected Commander and Governor of Bermuda and Mr. John Dutton, the new bailiff for Warwick Tribe.² Upon return, it was to collect colonial products, primarily sought-after tobacco, for delivery to England.

As a protégé of Sir Robert Rich, Captain Butler had been promptly elected governor. He was sent to Bermuda to replace Captain Miles Kendall, who served as an interim governor after the previous governor, Daniel Tucker, lost credibility with the major shareholders and had to depart for England. Although the elections reflected a deep division between different factions within the Company, the vote was cast and His Majesty, James I, confirmed Captain Butler as the third governor of Bermuda.³

At the end of November, after re-provisioning and loading colonial goods into *Warwick's* hold, a hurricane struck the island of Bermuda. Faced with a difficult choice, the ship's captain gave an order to drop the anchors and secure the ship in Castle Harbour. It was a desperate decision with dire consequences. As the hurricane hit, all the moorings gave way and the ferocious wind and waves drove the helpless vessel into the cliffs surrounding the anchorage.⁴

With the wreck of *Warwick* came the loss of the chance to export that year's crop of tobacco. Governor Butler was uncomfortably aware that the owner of the ship, the Earl of Warwick, and the Lords Adventurers of the Company would be disappointed with this turn of events; hence, he made a decision to outfit another ship, *Garland*, in place of the wrecked *Warwick*. *Garland* sailed for England with the tobacco and news of the disaster.⁵

Aside from the limited salvage attempts during the first few years after

the wrecking, which included raising several cannons and barrels with provision, interest in *Warwick* was short lived. The ship could not offer the financial rewards to make a more intense recovery viable. From the point of view of Bermudians, the salvage of *Warwick* was no match for that of the Spanish ships of the *Carrera de Indias* which occasionally foundered upon the islands' treacherous reefs.

The lack of contemporary interest in the shipwreck and the favorable environmental conditions for timber and artifact preservation produced a unique situation whereas *Warwick* is one of the largest and most complete English shipwrecks of the early 17th century. Such characteristics together with strong historical merit were also the primary factors driving the archaeological team to continue this project.

Summary of the Hull Structure

Warwick is preserved from the turn of the bilge, where the hull broke in half, to just above the first deck. The 2011 excavations uncovered approximately a 5 m x 5 m portion coinciding with the amidship (Fig. 3). The shipwreck structure was covered by a thick layer of sand and silt, as well as an undisturbed pile of stratified ballast. The top layer of ballast included large irregularly-shaped blocks of dolerite that were quarried somewhere in the area of Newcastle, England. Beneath these larger stones was a mixed layer of small to medium dolerite rocks, while the bottom-most layer consisted of highly compacted river pebbles mixed with gray clay-like bilge sludge.

Warwick's visible framing exposed in 2011 included the extremities of the floor timbers (wrungheads), first futtocks, and third futtocks; the second futtocks were covered by nearly undamaged ceiling planks (Fig. 4). With the exception of two frames horizontally fastened with trenails, the timbers overlapped loosely and the

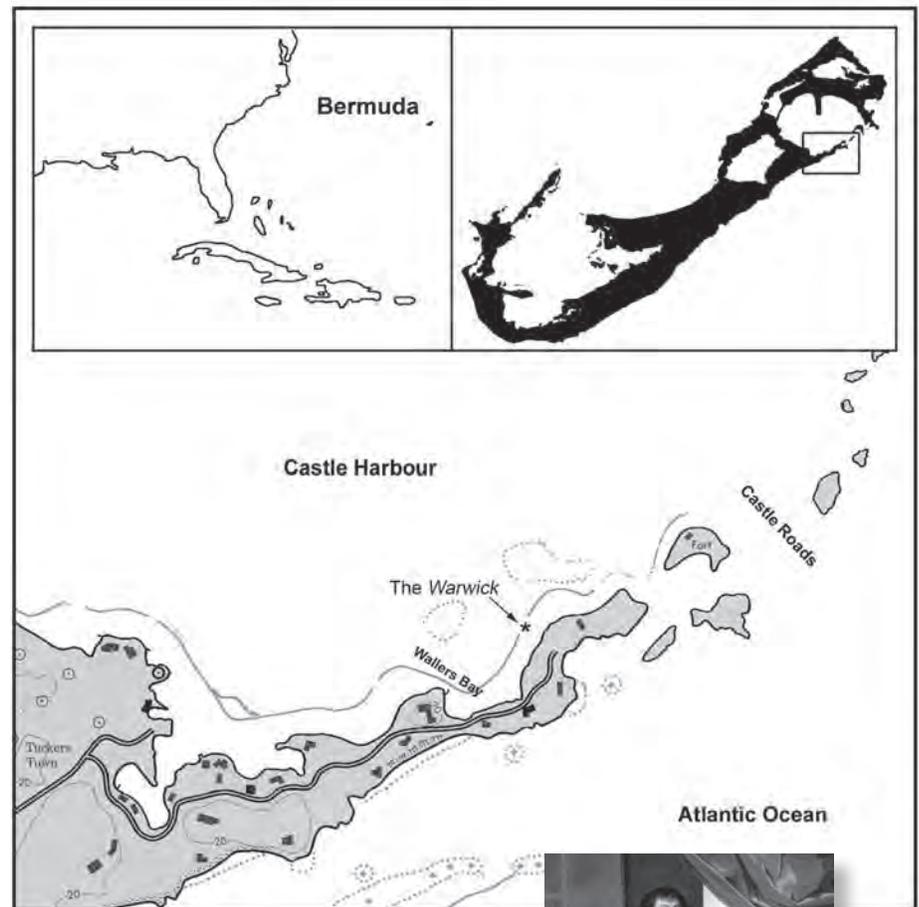


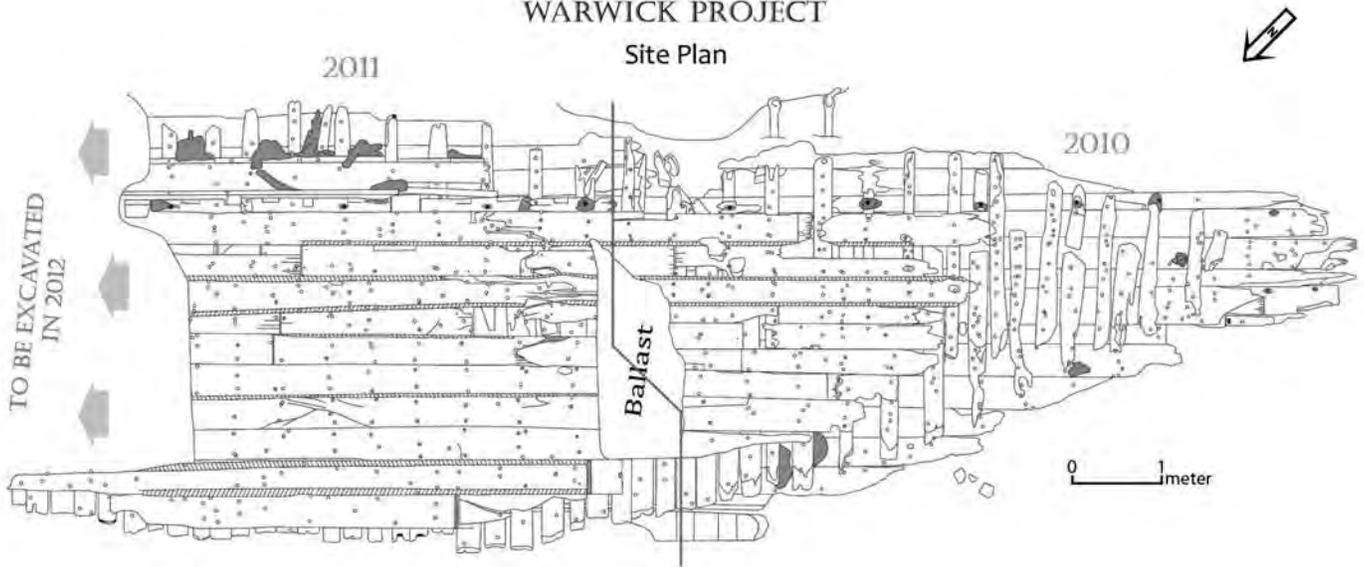
FIG 1
Location of the *Warwick* wreck site in Castle Harbour, Bermuda. October 2011 (P. Bojakowski and K. Custer).

FIG 2
Portrait of Sir Robert Rich, second Earl of Warwick (National Maritime Museum, London).

framing elements did not appear to be fastened to each other. The internal planking consisted of six common ceiling planks arranged in an alternating pattern with three stringers and a shelf clamp. The stringers were noticeably more robust than the ceiling planks. The external planking was composed of three distinct layers separated by tightly compacted caulking material. The innermost layer of planking had two significantly narrower and thicker strakes which have been identified as the ship's first and second wale. The second layer of structural planking, referred to as doubling, was only visible near the stern of the wreck. The doubling was protected by a third layer of sacrificial wooden sheathing. Excavation also revealed an intact portion of the deck. Observations of the position and arrangement of the shelf clamp, knees, and beams suggest they supported the first (or orlop) deck (Fig. 5). The lower remains of gunports were still discernible, and this deck

WARWICK PROJECT

Site Plan



FROM TOP

FIG 3

Site plan based on work carried out during the 2010 and 2011 field season. October 2011 (P. Bojakowski and K. Custer).

FIG 4

Rodrigo Torres recording preserved ceiling planks. July 2011 (J. Adams).

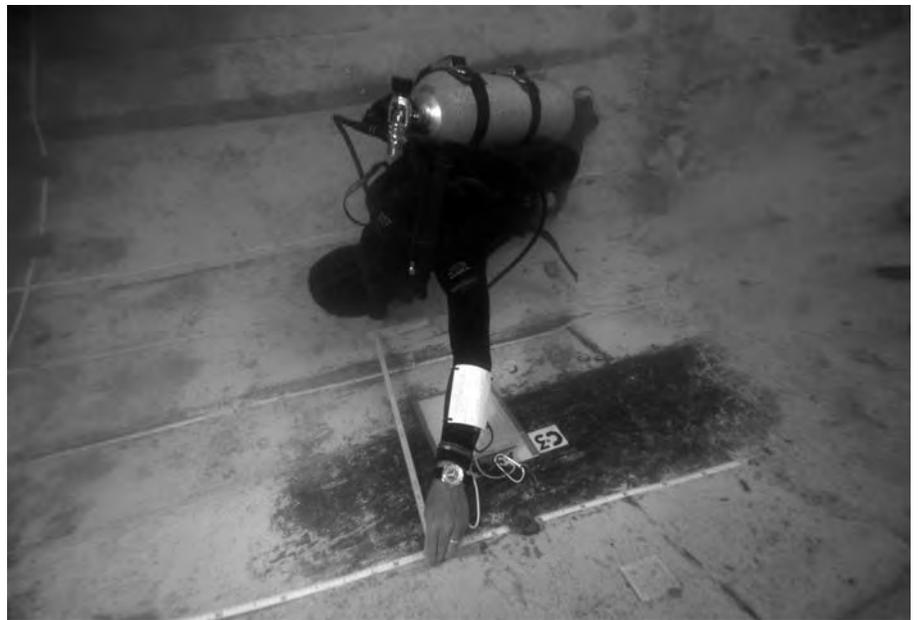
FIG 5

The arrangement of the lodging knees, beams, and deck planks. July 2011 (J. Adams).

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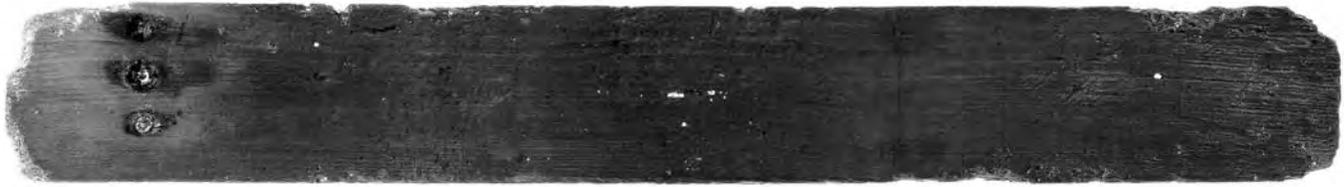
FIG 6

Details of the Plain Scale: front and back sides. October 2011 (P. Bojakowski).





Front Side



Back Side



would have most likely been the vessel's gundeck.⁶ A thick L-shaped waterway (which functioned as a gutter) was fastened to the hull with treenails and iron bolts and covered with deck planks. Directly above the waterway there was a run of thick planking or spirketting finished with filler boards.

Significant Artifacts

Aside from the single most important artifact, the ship itself, 492 artifact lots were recovered during the 2011 field season. The assemblage of artifacts from *Warwick* now includes a unique navigational instrument called a Plain Scale, remains of the ship's provisions, personal possessions including a comb and pipe fragments, rigging elements, ordnance and small arms, lead merchant weights, and even Roman pottery. Samples of ballast, coal, and wooden hull elements were also collected for further analysis and identification. Overall, the collection includes 38 samples of ballast rock, brick fragments, coal, and other rocks; 198 wooden artifacts and fragments; 92 metal objects; 6 leather pieces; 78 ceramic sherds and glass pieces, as well as 80 organic, inorganic, or composite artifacts.

Plain Scale

The most remarkable and diagnostic artifact recovered from *Warwick* is a

wooden ruler called a Plain Scale. It was discovered in 2010, the first year of excavation. The scale was wedged between the hull planking and one of the frames, protecting it from wear and degradation and preserving intricate markings.

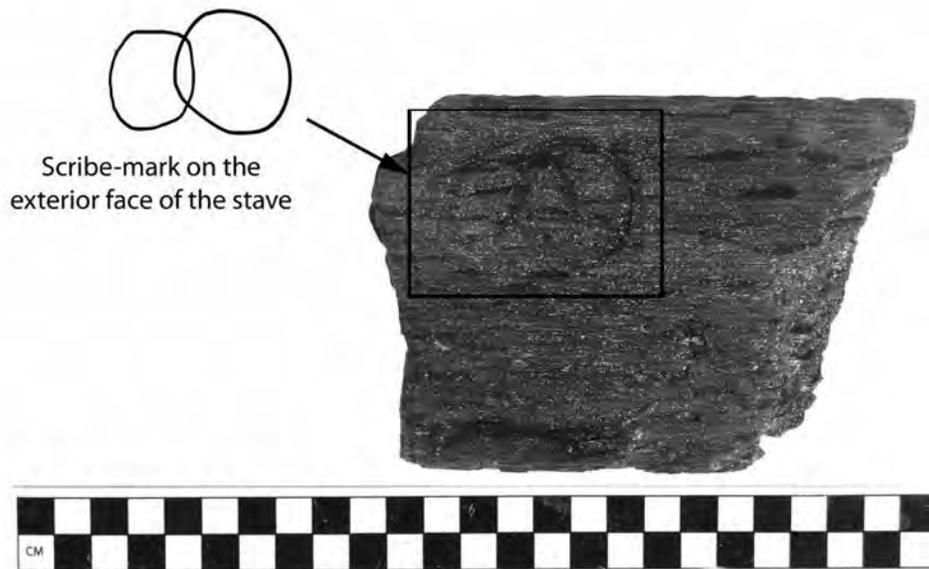
After soaking the scale in continuous baths of de-ionized water for over a year, more markings and numbers appeared (Fig. 6). Although we initially believed the artifact was a Gunter Scale, the newly revealed markings matched those of a Plain Scale illustrated and described in *Speculum Nauticum* by John Aspley in 1624. This treatise, printed only five years after *Warwick* sank in Castle Harbor, is one of the earliest writings about a Plain Scale's use in navigation and astronomy. The markings on the back of the Plain Scale indicate the number of miles to be sailed upon the eight rhumbs of a quadrant in order to raise or lower 1° of latitude, as well as the number of leagues to be sailed East-West along a latitude to meet those particular meridians. The scale uses the distance of 4.8 km (3 mi) per league and 20 leagues per degree of latitude.

Plain scales and Gunter scales were both navigational instruments used in the 17th century. While both scales had graduated markings on them, the markings were very different. The Plain scale contained a line of chords, a

line of rhumbs, and a line of leagues. These could be used by a navigator with dividers to determine how far a ship had sailed in leagues, as well as the change in latitude and longitude of the ship. A Gunter scale, also called Gunter rules, was a wooden scale with lines of logarithms, such as the line of sines, the line of tangents, and the line of inverse sine. The Gunter rule might also contain the line of rhumbs, chords, and leagues on it, but the main difference was the Gunter scale contained logarithms, while the Plain scale did not.

Aspley wrote that the scale was "in use with very few"⁷ before 1624. According to Waters, it became more popular after 1624 because "it was simpler than Gunter's Scale and it combined ease of manufacture and of manipulation with cheapness."⁸ The significance of the Plain Scale cannot be understated, as Aspley's work is listed in two essential 17th-century navigational books; the first is Captain John Smith's *Sea Grammar* and the second is William London's *Catalogue of the Most Vendible Books*, dated to 1627 and 1657, respectively. Plain Scales continued to be used on ships until the second half of the 18th century.

Warwick's scale was a very advanced instrument at the time and represents one of the earliest surviving examples;



it is possible more details might be revealed through continued cleaning and conservation, which are now underway at Texas A&M University's Conservation Research Laboratory. It is an artifact that represents advancements in navigational instruments when navigational knowledge was spreading by great leagues and bounds.

Organic Artifacts

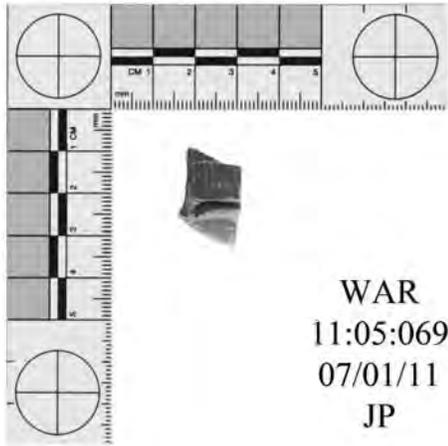
In addition to the Plain Scale, other wooden artifacts recovered include comb fragments, treenails and construction wedges, as well as fragments of cargo such as stoppers, barrel parts (staves, head boards, and hoops) and withies which were thin reeds that held the hoops in place around the barrels. These wooden artifacts represent standard shipping and storage containers (Fig. 7). They were found in association with a variety of broken bones and teeth. These have been tentatively identified by the authors as the butchered remains of either cows or pigs. It is possible that together the bones and barrel fragments represent provisions stored in the hold of the ship. Historical accounts of the wreck inform us that most of the readily accessible barrels of beer, provisions, and wooden boxes were

recovered from *Warwick* a year after the wrecking. *Warwick* is reputed to have been employed as a magazine ship for the Virginia Company based on historical mentions within the Bermuda archives. It has been widely assumed that this vessel was headed to Jamestown after bringing Governor Butler to Bermuda. It is curious, however, that there is not more evidence of cargo and supplies for Jamestown within the artifact record. The removal of provisions and possibly cargo from *Warwick* shortly after wrecking should not have entirely erased all the evidence of the myriad of supplies carried by a magazine ship to a fledgling colony such as Jamestown. It is hoped that the final season of excavation in 2012 and the ensuing historical research will reveal more evidence of a potential cargo, cargo manifest, or the intended final destination of *Warwick* and its occupants.

Ceramics

The ceramic assemblage includes highly deteriorated sherds of ordinary redware, either glazed or unglazed, stoneware, and pipe fragments. Interestingly, a number of sherds have been preliminarily identified by Adams as Roman *terra sigillata* (Fig. 8).⁹ This is a type of fine red slipware, also

known as Arretine or Samian ware, depending on origin. It was mass-produced starting in the first century B.C.E. and continued to be popular in the Roman provinces through the third century C.E.¹⁰ Frequently decorated with embossed figures and lines; this pottery has a strong chronology based on vessel shapes and decorative patterns. Unfortunately, none of the sherds found on *Warwick* during the 2011 season are diagnostic. The *terra sigillata* sherds were mixed in with the permanent ballast. Similar pieces of Roman ceramics were found in the ballast by the Bermudian diver, Edward B. Tucker during his salvage work on *Warwick* in 1978-79. These ceramics were identified in 1980 by I. Noël Hume of the Colonial Williamsburg Foundation, as two pieces of Roman Terra Sigillata. In addition they raised two sherds of shell-tempered Romano-British earthenware and a fragment of a potential Roman lead-glazed bottle from St. Remy in France.¹¹ It was Hume's estimation that this material was incorporated by accident during the process of dredging shingle ballast from the bottom of the Thames between the Tower of London and the London Bridge based on the common presence of Roman ceramics in this area of the river and contained



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FIG 7

A broken fragment of the barrel stave displaying a scribe-mark carved on its exterior face. October 2011 (P. Bojakowski).

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FIG 8

Example of a sherd identified as Roman *terra sigillata*. October 2011 (P. Bojakowski).

FIG 9

Lead merchant pan weight stamped with three emblems: a Roman numeral "I" surmounted by a crown, the sword of St. Paul, and the "angel and scales." October 2011 (P. Bojakowski).

within the ballast of other shipwrecks, including *Sea Venture*.¹²

Lead and Iron Artifacts

Three lead pan merchant weights were discovered on the site. Merchant weights offer a unique insight into the character of the voyage which brought *Warwick* to Bermuda. Although the assemblage is small, it represents an important mercantile collection. The lead weights bear the ciphers of English trade guilds, marks, and regal stamps. They also tell a human story about life and economic activities of early 17th-century England and their colonies. The smallest is stamped with three emblems: the sword of St. Paul, which was the mark of the city of London; the "angels and scales," which was the mark of the Plumbers Company; and a letter "I" surmounted by a crown, representing the English King James I (reign 1603–1625) (Fig. 9). The Plumbers Company based in London was responsible for the extremely important task of detecting false weights being used in the city and for seven miles around. The Plumbers Company was stripped of these rights in 1599; however, they were re-instated in 1611 eight years before the sinking of *Warwick*.¹³

Long lead strips called tingles with regularly spaced nail impressions along

the edges were also found in 2011. Although lead tingles were often used for repairs onboard a ship, there is no evidence that these were used in such a context on *Warwick* as they were found loose on the hull of the ship. To date no example of repairs have been discovered which is consistent with the working hypothesis that this was a newly built ship when it sank. Iron artifacts include common ship's hardware such as round bolts and square nails, but also a beautifully preserved c-hainplate with a bolt on one end and an iron strop on the other. In addition, the team raised an iron pintle and gudgeon assembly, a possible partial pommel or grip of a sword, and numerous other heavily concreted objects that have yet to be examined.

Ordnance

Warwick was particularly well armed for a magazine ship. When it came to rest on its starboard side, loose shot rolled across the deck and piled along the frames (Fig. 10). In addition to traditional round shot (i.e. cannon balls), the 2011 excavation revealed that *Warwick* carried a wide variety of fiendish ammunition used to damage rigging, kill sailors, and to puncture the hull of a ship, including bar shot, expanding bar shot, and spiked shot.

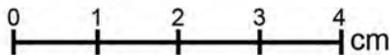


FIG 10

Concretions piled between the frames. July 2011 (J. Adams).

FIG 11

Lead powder-holder cap. October 2011 (P. Bojakowski).

Round shot was used for long distance engagement and creating holes in the side of a vessel. The others were used against the rigging and the crew.

In the 17th century, expanding bar shot was referred to as “langrel shot,” though in later centuries langrel shot and “langrage” would come to mean any shot used for tearing sails and rigging, particularly scrap metal enclosed in a canister or shoved down the barrel of a gun. Langrel shot initially described a type of bar shot that expanded and spun wildly when fired, devastating both rigging and crew. Each end consisted of a metal ball or hemisphere cast on a long bar. The bars were linked with shackles so the shot would collapse when loaded and expand when discharged.¹⁴

Spiked shot was referred to as “cross-bar shot” during the 17th century. It consisted of an iron or lead ball cast around an iron spike which was sharpened and protruded 15.24 cm (6 in) to 20.32 cm (8 in) from each side. Captain John Smith (1627) notes that before firing, cross-bar shot was “armed” by wrapping oakum and canvas around the end of each spike.¹⁵ Like langrel shot, it was used against lines, masts, and sails as well as the exposed sailors. Manwayring (1644) notes that

both langrel and cross-bar shot were ineffective when fired directly against the hull of a ship, unless fired from a “very great” piece of ordnance.¹⁶

Most of *Warwick’s* ordnance was salvaged between 1620 and 1621. Bermuda’s governor ordered diving teams to recover cannons from the wreckage. In anticipation of the storm, the ship’s guns had been securely lashed to the deck. Working with their lungs and brute force alone, the 17th-century salvage divers were able raise eight guns. These were used to bolster Bermuda’s colonial defenses against the Spanish and other enemies of the King at Ft. Southampton.¹⁷ Working with the Philadelphia Maritime Museum, Edward B. Tucker, raised three more cannon in 1979. We are hopeful that some remain on the wreck site.

Close survey with a metal detector led to the recovery of small arms ammunition, including a quantity of musket, pistol, and grape shot of various calibers. A number of lead powder-holder caps were also discovered; they were originally associated with wooden powder flasks (Fig. 11). Each flask would have carried the measured amount of black powder required for a single shot. This arrangement saved a great deal of time in reloading. Since a soldier would normally carry 12 of them on his bandolier, they were referred to as the 12 “apostles.”

Conclusion

The remains of *Warwick* are one of the largest and most cohesive extant sections of an early 17th-century English ship.¹⁸ The wreck is a prime example of the vessels that played a fundamental role in supplying the nascent English settlements in North America and perhaps other less reputed functions. Archaeological evidence suggests that *Warwick* was built in a traditional style at a vital time in English ship design and construction. It has a unique place in both the history of shipbuilding and the social history

of Bermuda. The ship is an iconic representation of the many English business ventures that occurred on board vessels sailing between England, Bermuda, and Jamestown, carrying colonists, supplies, and tobacco between Europe and the New World. As such, each season *Warwick* teaches us more about the island's history and the 17th-century Atlantic world.

Acknowledgments

The authors would like to express their sincere gratitude for the support the project has received from the National Museum of Bermuda, Institute of Nautical Archaeology, and the Center for Maritime Archaeology and Conservation. The project was also made possible in 2011 due to the outstanding contributions of Rosewood Tucker's Point, the Perot Foundation, Tucker's Point Dive & Water Sports Centre, KPMG Bermuda, the Global Exploration and Oceanographic Society, Jason Paterniti, Jason Carne and other individuals and businesses of Bermuda.

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Notes

- ¹ Harris 1997, 45–82.
- ² Bernhard 1985; Craven 1937.
- ³ Hallett 2007, 102–121.
- ⁴ Hallett 2007, 126.
- ⁵ Hallett 2007, 125.
- ⁶ Jonathan Adams, pers. comm.
- ⁷ Aspley 1977, 8.
- ⁸ Waters 1958, 445.
- ⁹ Jonathan Adams, pers. comm.
- ¹⁰ Oswald and Pryce 1920, 9–12.
- ¹¹ Hume 1980, 2.
- ¹² Hume 1980, 2; Jonathan Adams, pers. comm.
- ¹³ Wingood 1982, 344
- ¹⁴ Smith 1968, 67; Manwayring, 1972, 59.
- ¹⁵ Smith 1968, 67.
- ¹⁶ Manwayring 1972, 31.
- ¹⁷ Hallett 2007, 131.
- ¹⁸ Jonathan Adams, pers. comm.



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Chris is working in Nevis, West Indies, to test the waters for shipwrecks using remote sensing technologies. He holds degrees from Iowa State University in History and East Carolina University in Maritime Studies. Chris has extensive Cultural Resource Management (CRM) experience participating in and directing all phases of investigations primarily on terrestrial sites throughout the Midwestern United States. Additionally, Chris has maritime experience on projects in the United States, Bermuda, Canada, West Africa, and the Caribbean.

FACING PAGE FROM TOP

FIG 1

Location of Nevis and *Solebay*.

FIG 2

Archaeologist Lillian Azevedo and Professor James Hewlett, Finger Lakes Community College, documenting anchor (P. Diamond).

FIG 3

Chris Cartellone and Justin Parkoff observing carronade (P. Diamond).

Nevis Shipwrecks PROJECT SOLEBAY

Today, the tiny island of Nevis (less than 93 km²/36 mi²) in the Lesser Antilles seems insignificant and largely unknown in modern geopolitics. Yet, this tranquil and picturesque Caribbean island produced tremendous wealth from the sugar industry during the 17th through 19th centuries. Competition for these resources fueled imperial conflicts between the British and French in Nevis.

In October 1781, after Generals Washington and Rochambeau defeated General Cornwallis' army at Yorktown, the French navy sailed south into the Caribbean. There, French forces aggressively sought to exploit the conflict by seizing valuable British sugar islands before the cessation of hostilities. To this end, in January 1782, dozens of French troop transports and logistical vessels landed 7,000 soldiers on Nevis' sister island of St. Kitts to assault and capture the British fortress at Brimstone Hill, escorted by 21 ships of the line. Upon hearing the news, Rear Admiral Sir Samuel Hood led 22 British warships from Antigua to relieve the besieged St. Kitts and Nevis islands. Among these vessels was a sixth-rate, 28-gun frigate, HMS *Solebay*. During the subsequent Battle of Frigate Bay, *Solebay* wrecked off the southwest coast of Nevis.

During the fighting, *Solebay* acted as a repeater vessel, meaning she sailed out away from the line of battle, assigned to passing signals from the flagship to the rest of the fleet. As the British approached Nevis and rounded the southwest coast, they moved north to engage the French. *Solebay's* mission required sailing dangerously close to the coast to maintain a visible position. During this task, *Solebay* grounded. As the British and French fought, Captain Charles Holmes Everett's crew worked to free *Solebay*. Soon, *Solebay* attracted cannon fire from French

warships. Without alternative options and fearing capture, Everett ordered his crew ashore to Nevis as they set *Solebay* afire. After an hour of burning, the flames reached the 160 barrels of gunpowder below deck and exploded. Despite *Solebay's* loss, Hood's fleet secured a tactical victory against the French.

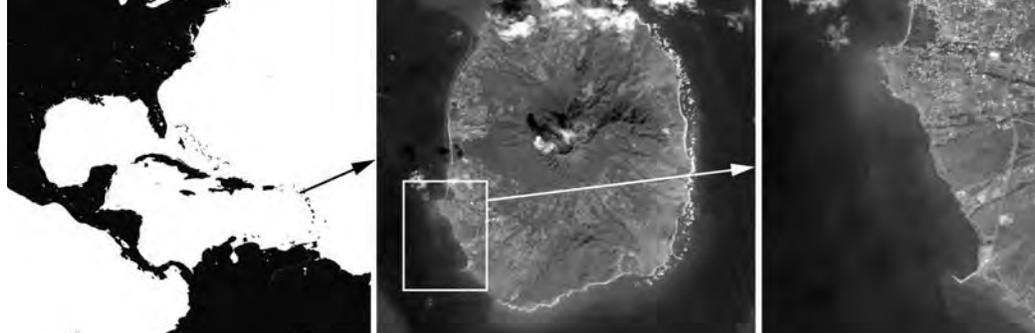
A British naval architect, Thomas Slade (who designed Admiral Nelson's 1805 *Victory* during the same period), drafted plans for *Solebay* in 1760 as part of the new *Mermaid*-class frigate. Built in 1763, by 1782 *Solebay* had spent two decades undergoing technological updates including the addition of copper-bottomed sheathing and the partial substitution of carronades for long-guns. Only such metal materials appear to have survived in the archaeological record. The absence of organics on this site suggests that the hull has long since been destroyed, first from the explosion, and subsequently through the site formation processes that scattered the debris field and prevented deposition of timbers in sand. Despite this archaeological loss, an exciting story can be told through the material record.

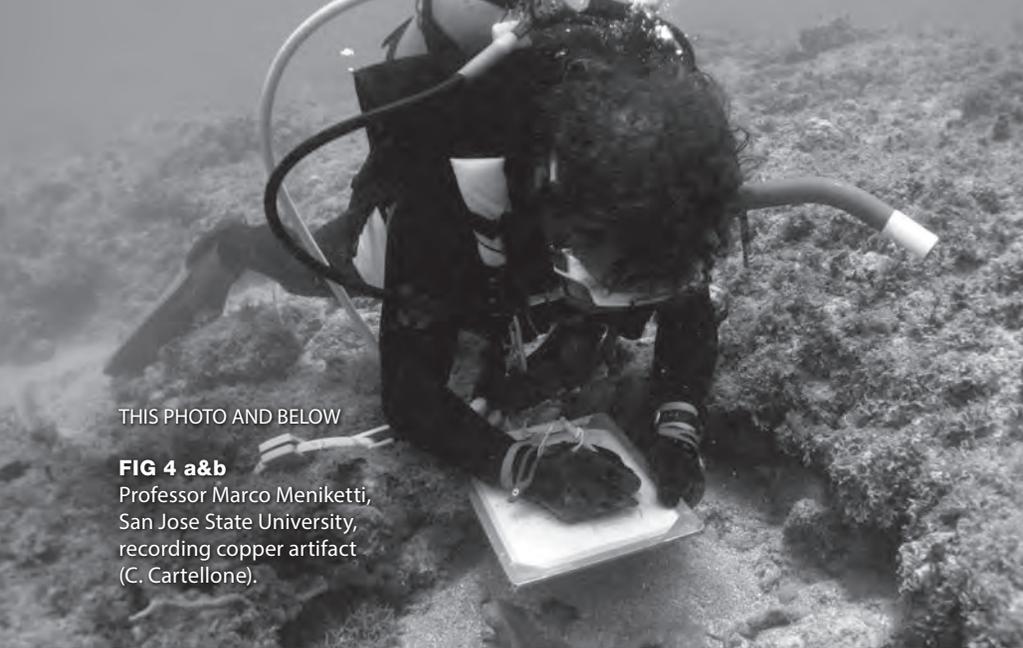
For five weeks in 2011, two Texas A&M University graduate students led a collaborative team of volunteer students and professors from San Jose State University, Finger Lakes Community College, and local Nevisians to survey and document the proposed remains of HMS *Solebay*, with the objective to study and delineate the wreck and confirm the vessel's identity. *Solebay* represents an archaeological signature created as a product of the European wars. The project's broader purpose was to initiate underwater archaeological shipwreck investigations on Nevis (Fig. 1).

The Institute of Nautical Archaeology (INA) partially

funded the team and permitted use of a variety of INA equipment including underwater cameras, a magnetometer, and a differential Global Positioning System (GPS). With these tools, the team delineated the site and recorded artifacts using basic SCUBA equipment. Standard underwater archaeological recording techniques included direct measurements, bearing-distance measurements, circle searches, metal detecting, photography, and video recordings (Fig 2; Plate 13–p. 69). Archaeologists established a survey grid over the known site and used the magnetometer to locate a larger debris field. By the end of the field season, the team was fairly confident with the site delineation, despite having located only one anchor and six cannon. These included two carronades and four long guns.

The site's location in shallow water, averaging less than 8 m (25 ft), allowed for long dive times, up to two hours each. These ranged from two to three dives per day. Conditions at the site were fairly good, with clear visibility, though afternoon thermal heating often created an environment of underwater surges, clouded visibility, and sometimes a moderate current. Calm morning conditions generally proved ideal for meticulous measurements, notes, drawings, and photographs. The location is vulnerable to seasonal storms and Atlantic hurricanes that scour the seafloor. While the artifacts have provided shelter to some marine life, the site is largely devoid of coral. The hard volcanic substrate offers limited possibilities for buried deposition of cultural materials, as evidenced by the guns and iron ballast sitting proud of the bottom, though a few sandy pockets provide the opportunity for more extensive preservation (Fig. 3). For example, numerous copper tacks, which were easily found with simple





THIS PHOTO AND BELOW

FIG 4 a&b
Professor Marco Meniketti,
San Jose State University,
recording copper artifact
(C. Cartellone).

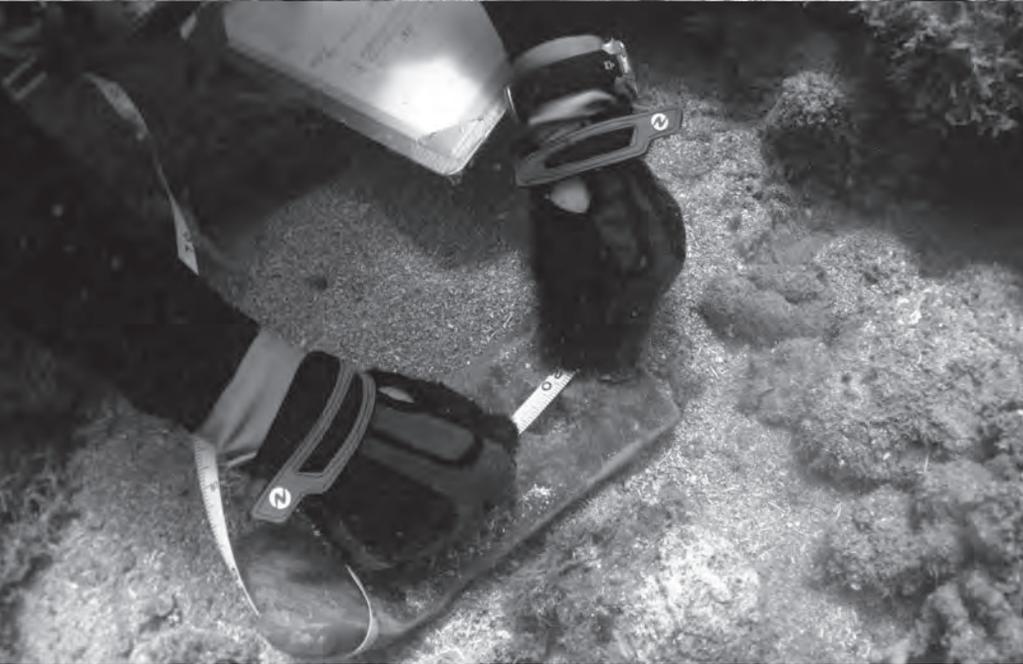


FIG 5
Justin Parkoff and John
Schlagheck recovering
copper chain (C. Cartellone).

hand fanning in these sandy pockets, were likely used to secure copper sheathing to the wooden hull.

Despite the disarticulated site and dynamic environment, countless artifacts remain (Fig. 4). Notable among the remains were several amorphous encrusted artifacts that appear manmade. However, they would require intensive excavation and conservation to identify. Even then, many of these may be unidentifiable metal or bleeds as the original materials likely have disintegrated leaving a hollow cavity. Therefore, after the team used a metal detector to verify the metallic nature of these concretions, attention was shifted to more productive efforts documenting recognizable materials, making optimum use of limited time and resources.

The project attracted the attention of Brimstone Hill Fortress manager Mr. Cameron Gill. Today the fortress houses a museum on the grounds as a National Park and UNESCO World Heritage Site. INA's reputation preceded the team and encouraged Gill to support the research. Through the Brimstone Hill Society, the team received funding to recover and conserve close to 70 small diagnostic artifacts, all of copper or lead (Fig. 5; Plate 14—p. 69). Archaeologists selected these items based on their perceived diagnostic value and ease of conservation since any surviving iron is either heavily encrusted or only exists as a hollow cavity concretion.

The initial plan of a strictly non-intrusive survey was altered by both adequate funding for recovery and conservation, and assurances of preservation and long-term stewardship by the Nevis Historical and Conservation Society (NHCS). Artifacts have been undergoing conservation at Texas A&M University's Conservation Research Laboratory (CRL) in College Station, Texas. Artifacts recovered include copper tacks, nails, lead weights, a trigger guard likely from a sea service

musket, a lead gun apron, and musket balls. Most of them have recently finished conservation and are ready for the process of technical drawings and analysis. Initial observations have noted a few broad arrows stamped onto some of the metal objects which confirms their British origin.

Once conservation and analysis has been completed, the artifacts will be returned for exhibit in the Alexander Hamilton Museum on the island of Nevis. The Brimstone Hill Society fully supports curation of these artifacts on the island of Nevis. In return, project and artifact images will be provided for a second display at the fortress museum on St. Kitts. The two museums may agree to exchange materials for exhibit. This arrangement will work well for sharing *Solebay's* story with a broader audience.

Additionally, the artifacts will receive high-tech documentation through the use of a FaroArm 3D laser scanner, available through the Texas A&M University's Center for Maritime Archaeology and Conservation (CMAC). This device produces accurate digital 3D scans which can be examined by anyone with access to basic PDF software. Once the artifacts are returned to the NHCS, these virtual models will complement photographs. An online virtual museum exhibit will permit scholars and the general public to access artifact details including precise measurements. A global audience that otherwise may never have the opportunity to visit Nevis or St. Kitts will be able to view the artifacts raised from this historic shipwreck.

Project *Solebay* has proven productive in a number of ways. The material culture supports the identity of the shipwreck as *Solebay*. The telling of this vessel's history provides a naval perspective from the lower echelon, one that transcends the American Revolution and explores British and French imperial conflict involving foreign colonial possessions with African slaves. While the potential for

finding another related debris field, it is highly likely that other guns, anchors, copper sheathing, and ballast have been salvaged over time. The remaining archaeological evidence reveals that *Solebay's* crew adapted technology newer than when she was constructed, including copper sheathing and carronades.

Future research around Nevis should continue to locate and document other vessels through surveys and local informants. Such maritime surveys may identify more materials from *Solebay*, including other cannon and swivel guns. Project *Solebay* is an initial step toward the greater effort to reveal a maritime history of Nevis based on underwater archaeology.

Acknowledgments

Project *Solebay* succeeded due to generous support from a collaborative group of institutions and individuals. At Texas A&M University: the Institute of Nautical Archaeology, the Center for Maritime Archaeology and Conservation, the Department of Anthropology, Professor Donny Hamilton, and Justin Parkoff; Professor James Hewlett and his students at Finger Lakes Community College in New York, Professor Marco Meniketti and his students at San Jose State University in California, David Small at the University of Bristol, Lillian Azevedo at the University of Southampton, Adnams Southwold and the many unnamed folks with the Nevis Historical and Conservation Society, Paul Diamond at the Nevis Maritime Archaeology Group, Cameron Gill and the entire Brimstone Hill Society, Ellis Chaderton and his team at Scuba Safaris, Spencer Hanley and his officers at the Nevis Air and Sea Ports Authority, Envision Mapping, T. Kurt Knoerl and the Museum of Underwater Archaeology at the University of Rhode Island.

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Joshua Daniel serves as a terrestrial and underwater archaeologist for Tidewater Atlantic Research. For over nine years he has participated in terrestrial and underwater archaeological projects abroad and in the United States along the eastern seaboard and the Gulf coast. As an archaeologist with Tidewater Atlantic Research, he is responsible for the analysis of remote-sensing data, creating GIS projects, recording archaeological sites using the Vulcan Spatial Measurement System, and three-dimensional reconstructions using both Rhinoceros and AutoCAD.

The City Point, Virginia Shipwreck Survey

A REMOTE-SENSING AND PHOTOGRAPHIC INVESTIGATION

As a river with one of the longest and richest histories in North America, the James River has long been considered an area of high archaeological and historical importance. Centuries of human habitation have left a rich archaeological record, both above and below the water. Submerged archaeological sites are threatened by human activities; both looting and regular dredging of the ship channel presents threats to the preservation of the shipwrecks in the river.¹ Among a list of threatened sites on the James River, Kevin Foster, former head of the U.S. National Park Service Maritime Heritage Program, includes the docks and anchorage at City Point, Virginia. Foster describes sidewheel ferries, three-masted schooners, and at least one large wooden ship in the area.² Historical documents also suggest that a number of vessels were wrecked or abandoned in the vicinity as early as the late-18th century, while undocumented

historic wrecks could date to as early as 1613.

Due to the extensive history of the area and the number of wrecks visible above the water surface, in 2011, I directed a remote-sensing and photographic survey of the tidal flats east of City Point (Fig. 1). The fundamental goal of the City Point Shipwreck Survey was to determine the number of wrecks in the survey area and identify vessel types and dates, if possible. The diversity of wrecks in this area provides a unique resource for archaeologists, and this survey is a starting point for future archival and archaeological research.

Historical Background

Following the establishment of Jamestown in 1606, the area at the confluence of the James and Appomattox Rivers was colonized by the English in 1613 when Sir Thomas Dale founded the settlement of

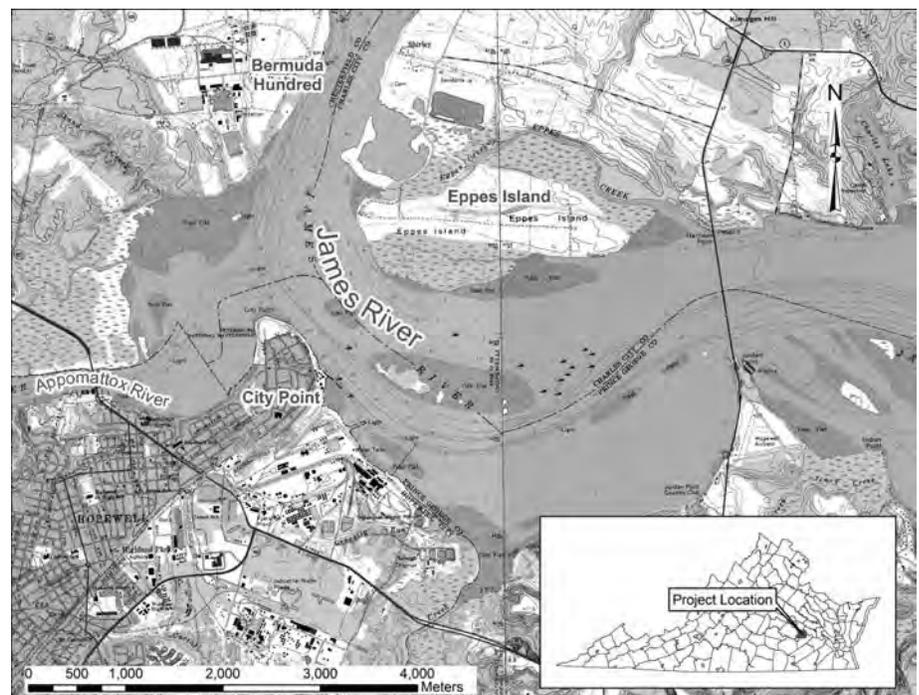


FIG 1
The location of the City Point
Shipwreck Survey Project.
(J. Daniel).

Bermuda Hundred.³ The settlement, located on the James River immediately north of the Appomattox, was named for the number of days Dale had spent on the Bermuda Islands after being shipwrecked on *Sea Venture*.⁴

Colonists began to settle the area to the south of the Appomattox River shortly after the establishment of Bermuda Hundred. The southern settlement was called Bermuda City, but was soon renamed Charles City in honor of Prince Charles (later Charles I) and became one of four principal cities when the colony was divided into four corporations.⁵ The location, which would eventually become City Point, was selected for several key reasons, including a defensible promontory, fertile soil, and a deep anchorage in the James River, a quality which eventually made City Point an important port. The initial settlers experienced numerous difficulties. They received little food and clothing from the Virginia Company, leading to such a sad state of affairs that by 1619 the settlement was reduced to only six decaying houses.⁶ The early settlements in this area were destroyed in the 1622 Powhatan Uprising.

In 1635, the lands at City Point were granted to Captain Francis Eppes. Although no primary documentation exists, tradition suggests that he arrived with his brother in 1622 aboard *Hopewell*. Francis Eppes financed passage for himself, his three sons, and 30 servants to Virginia, where he received 34 headrights (land grants) equaling 688 hectares (1,700 acres). By the time of his death in 1674, he owned 800 hectares (1,980 acres) on the south side of the James River and 230 hectares (572 acres) on what is still known today as Eppes Island.⁷

In 1731, Bermuda Hundred was established as an official tobacco inspection station.⁸ The following year a ferry was established at City Point, but by 1770 Richard Eppes, a great-great-grandson of Francis Eppes,

complained that the ferry was not convenient and had fallen into disuse.⁹ Perhaps this abandoned ferry is among the collection of shipwrecks in the tidal flats.

The Revolutionary War touched City Point only briefly. During the Virginia Campaign of 1781, British forces under the command of Brigadier General Benedict Arnold twice sailed up the James River in an effort to control strategic locations in Virginia. On the first occasion, Arnold led a mission from Westover to Richmond and American militia forced British ships following the expedition to retreat from the Appomattox River,¹⁰ firing on the British vessels as they passed City Point.¹¹

On the second occasion, 24 April 1781, British forces used City Point as a landing for both supplies and men.¹² After destroying thousands of hogsheads of tobacco, a ship, and a number of vessels in the shipyard at Petersburg, British forces marched to Osborn's Landing, upriver from City Point. There they captured two ships, three brigantines, five sloops, and two schooners. In addition, four ships, five brigantines, and a number of other vessels were burned and sunk.¹³

A 1787 letter from Christopher Roane describes City Point as a rough and dangerous place. Roane complained that he expected his salary to be at least 40 pounds more than the previous year, "as the trouble and fatigue is greatly increas[ed]."¹⁴ He goes on to state that once in trouble, "it will be too late to apply to a magistrate after we get our brains beate out or nock over board. I can venture to say that two-thirds of the people is as much alarm'd at a parcel of drunken sailors as they wou'd be at so many devils."¹⁵ Describing the condition of the town itself, Roane paints a picture of a bleak and rough atmosphere with little more to offer than scant accommodations for seamen, four houses and two rum shops. Still, numerous vessels offloaded their freight there in 1787, for in a

letter dated 7 August, Roane reports to Governor Randolph, "[a]t the port of City Point there has been about sixty-five vessels discharged their cargoes the last Quarter at that place."¹⁶

In June 1816, the first regular steamboat line servicing City Point was created.¹⁷ It was during this period that City Point became an important trading station and with the rise of steamboats, the location became one of the original stops on the Norfolk-to-Richmond run.¹⁸ In 1818, the new steamboat *Norfolk* began traveling between Norfolk and Richmond twice weekly.¹⁹ *Norfolk* overnighted at City Point on the trip upstream, and eventually became the primary vessel serving the James River in the 19th century. Other steamboats like *Petersburg*, *Potomac*, and *Richmond* connected City Point with port cities in Washington D.C. and Virginia. City Point's growth during this phase of its history led to its incorporation in 1826.²⁰ Further development of City Point was fueled, in part, by the arrival of the railroad, making this an important transit point for rail and river-borne commerce. In 1838, the first train linked City Point and Petersburg.²¹ An article from the 25 August 1827 edition of *The Times* mentions the loss of several lighters at City Point, but this is the only published announcement of pre-Civil War shipwrecks in this area that came to light using searchable newspaper databases.²²

During the American Civil War, the James River played a vital role in both Union and Confederate strategic plans. In May 1862, Union Commander John Rogers of the ironclad *Galena* led a force, including two other ironclads, *Monitor* and *Naugatuck*, along with the propeller-driven sloop of war *Wachusett*, the gunboats *Port Royal*, *Maratanza*, and *Aroostook*, and several smaller vessels, up the James River with the goal of forcing the Confederate capital of Richmond to surrender.²³ After a very brief exchange of fire

between the flotilla and Confederates at City Point, Rogers continued upstream. On 15 May the fleet arrived at Drewry's Bluff, where there was a brisk exchange of fire. The Union force was repelled by a battery and infantry in rifle pits, resulting in 12 killed and 15 wounded aboard *Galena*, and the fleet returned to City Point (Fig. 2). For the next three months, a number of small skirmishes took place at City Point. By 17 August, when the Union fleet headed downstream to Fort Monroe, the once-burgeoning port was left in ruins. City Point would not see Union forces for another two years.

By the spring of 1864, Union Lieutenant General Ulysses S. Grant's plan for a campaign against the Confederate capital of Richmond included the return of Union gunboats to the James River, along with forces under Major General Benjamin F. Butler. On 5 May 1864, General Butler occupied City Point and Bermuda Hundred and a witness to the destruction wrote: "Dr. Eppes' house [Appomattox Manor]...was perforated with scores of cannon-shot holes.... This cannonade had so effectually ventilated the house that there was but one weather-tight room in it....The wharf at City Point had been burned... and I found only the charred piles remaining."²⁴

On 18 June 1864, General Grant established his headquarters at City Point, ordering Brigadier General Rufus Ingalls to begin construction of a supply depot that would serve both the Army of the Potomac and the Army of the James. Within only a few months, City Point was transformed from a town with only a few burned wharves and warehouses to a port supplying 125,000 troops and 65,000 animals with the capability of supplying upwards of 500,000 soldiers.²⁵ It quickly became the second largest city in Virginia. General Ingalls described the depot at City Point as "one of the most convenient, commodious, economical, and perfect ever provided

for the supply of armies."²⁶ He went on to report "[t]here was an average of some 40 steam-boats of all sorts including tugs, 75 sail vessels, and 100 barges daily in the James River, engaged in the transportation of supplies, and plying between that river and the Northern ports."²⁷ In addition to mail and passenger service, these ships brought cavalry and artillery horses, mules, ammunition, clothing, subsistence, and other supplies to City Point while taking spent horses and unserviceable equipment back to Washington.

An inviting target, the depot became the victim of what was later discovered to have been an act of Confederate sabotage (Fig. 3). On 10 August 1864, Assistant Engineer C. L. McAlpine wrote:

*We had an excitement here yesterday at 11:25 a.m.... a Boat loaded with tons of powder, shell and fixed ammunition of all kinds was laying temporarily at the ordnance wharf, when from some unknown cause an explosion took place, five boats in the neighborhood were sunk or blown to atoms—180 feet of wharf is entire extinct—440 ft. of our large warehouse was sent up over the bluffs. The offices built for the Q.M. and all other buildings in the neighborhood are blown to atoms. A perfect shower of shells in one direction, saddles and bridles in another. Muskets in another &c &c Masses of Timber. Iron and debris of all kinds were thrown & scattered within a circuit of a mile. The loss of life has of course been heavy. The Surgeons reported last night 52 bodies found and about...100 injured.*²⁸

Subsequent reports identified the barge *Col. E. E. Kendrick* as the source of the explosion. *Kendrick* reportedly contained 20,000 to 30,000 rounds of artillery shells as well as 75,000 to 100,000 rounds of small arms ammunition and exploded while being loaded with percussion shells.²⁹

The barge *Major-Gen. Meade* and another vessel, *J. C. Campbell*, sank in the explosion and a local newspaper reported that a schooner was among those vessels mentioned by McAlpine.³⁰

Several other vessels were reported lost or sunk in the vicinity of City Point. On 27 November 1864, USS *Greyhound* exploded a few miles below Bermuda Hundred. A Confederate coal torpedo was blamed for the explosion, but this was never definitively proven.³¹ Another vessel, the canal barge *Oliver Little*, was abandoned at City Point in August 1864, described as "rotten and worthless."³²

Like the rest of the South, tidewater Virginia's economy following the war was devastated. The previously lucrative cotton trade was destroyed by four years of war, and the triangle of trade that existed between the northeast United States, the South, and Europe was broken.³³ In addition, import duties prevented the importation of iron and machinery, delaying the use of those materials to manufacture superior iron steam-powered ships. Steamboat service was slow to revive due to the numerous obstructions and sunken vessels in the James River. Large-scale efforts to remove these navigational hazards were not made until the 1870s and in 1871, *John Sylvester* was the only steamer making regular runs on the river.³⁴

By 1910, the population of City Point was only 300, almost the same as it had been before the Civil War.³⁵ Two years later, the E. I. DuPont de Nemours Company, attracted by the city's deep port, rail connections, and reliable water supply, purchased 728 hectares (1,800 acres) from the Eppes family to build a dynamite factory. With the onset of World War I, operations shifted from the production of dynamite to guncotton, an ingredient in smokeless powder for firearms.

War demand prompted a massive expansion of the DuPont facilities, quickly exhausting the local labor pool.



FIG 2
USS *Galena* after the battle at Drewry's Bluff showing damage sustained from Confederate batteries. 1862 (J. Gibson).



FIG 3
A photograph of the wharves at City Point after the explosion of the ordnance barge. August 1865 (Library of Congress).



FIG 4
Joshua Daniel adjusting the sonar record. August 2011 (J. Broadwater).



FIG 5
Dr. Broadwater monitoring the navigation computer. August 2011 (J. Daniel).

By 1916, the population of City Point had exploded to 40,000 to meet the labor shortage, and in the same year the General Assembly approved a charter for the City of Hopewell, reportedly named for the ship that brought Francis Eppes to the New World.³⁶ City Point was annexed by Hopewell in 1923.

Needing a larger commercial fleet to export American goods and to counteract losses from German U-boats in World War I, the government passed the Shipping Act of 1916, creating the Emergency Fleet Corporation (EFC). The EFC would oversee the construction and maintenance of a

fleet of merchant ships that ultimately numbered 2,247.³⁷

The cessation of hostilities in 1918, decline in commerce, depression in shipbuilding, and technological advances made many of these ships obsolete.³⁸ In 1920 and 1921, most of these vessels were taken to Claremont, downstream from City Point on the James River, and attempts were made to auction off the fleet at a fraction of their construction costs. Ultimately, some of the ships made it as far upriver as City Point. A June 1920 issue of *The American Marine Engineer* notes the difficulties the EFC was having taking care of its ships, “Recently a number of these vessels were taken up the James River to City Point, Virginia, into fresh water, in order to protect the hulls from the destructive salt water borers. A number of these vessels are laid up at City Point, with merely a skeleton crew aboard to look after the property of the government.”³⁹

With its river, rail, and road connections, Hopewell continued to attract various businesses, including the chemical industry. Operations at the Tubize Artificial Silk Company and Allied Chemical continued through the Great Depression.⁴⁰ But the chemical industry at Hopewell did not come without a price. On 24 July 1975, Life Sciences Products voluntarily closed its doors after a number of their employees exhibited symptoms indicating high exposure to the chemical kepone.⁴¹ Kepone, an insecticide, was developed in the 1950s and patented in 1968 by Allied Chemical. Subsequent investigation proved the chemical was being illegally dumped into the James River. U.S. Environmental Protection Agency testing detected kepone in the air 26 km (16 mi) away from the Hopewell plant, in the river 64 km (40 mi) away, and in shellfish up to 100 km (64 mi) away.⁴² The toxic spill destroyed the James River’s commercial fishing and oyster industry. In 1988, a fishing ban was lifted, although a fish

consumption advisory is still in effect due to the levels of kepone in river sediments.⁴³ In spite of this setback, the local economy of Hopewell and City Point continues to be supported by the military presence at Fort Lee and an active chemical industry.

Survey and Analysis

On 11 and 12 August 2011, a team of three archaeologists, including Dr. Gordon P. Watts, Jr., Dr. John Broadwater, and project director Joshua Daniel, conducted a remote-sensing investigation in the James River east of City Point, Virginia. The survey was carried out using a Klein 3900 445/900 kHz digital side scan sonar. Vessel positioning was maintained with a Trimble differential global positioning system used in conjunction with Hypack navigation software. A Geometrics G-858 magnetometer was also mounted to the bow of the 7.3 m survey vessel to supplement side scan sonar data.

The side scan sonar survey was conducted around high tide on the first day of operations. The original survey area was modified due to budgetary constraints and the presence of shoal water both immediately north of an unnamed island in the James River and south of Eppes Island. Survey transects were maintained at 100 m, except where wrecks and shallow water provided obstructions. The range scale of the side scan sonar was set to 125 m using low frequency, which provided 100% coverage of the survey area. Once the accessible area was completely covered, additional high-frequency side scan sonar data were acquired at a 50 m range scale over specific wreck sites, providing a more detailed, higher resolution sonar record (Fig. 4).

As the project continued the next morning at low tide, when sonar survey is impossible, exposed portions of the wrecks were photographed to record and verify construction features documented in the side scan sonar data. Survey vessel tracks were



recorded in the Hypack program along with photograph numbers for future reference (Fig. 5).

The sonar data were processed with Chesapeake Technology's SonarWiz. Analysis of the side scan sonar data identified 42 wrecks near City Point that have been divided into five classifications: ocean-going vessels (16 examples), combination barges (15 examples), rectangular barges or ferries (7 examples), vessels of unknown type (3 examples), tugboats (1 example) (Fig. 6). All 42 wrecks exposed on the river bottom were outlined in that program and approximate lengths and beams were measured. This process was complicated by wrecks that were moored adjacent to each other, blocking the acoustic signals sent by the side scan sonar and creating shadows in the sonar record. Additional vessel measurements were obtained from high-resolution aerial photographs provided by the U.S. Geological Survey.

The 16 ocean-going vessels include wooden wrecks and an iron or steel vessel that exhibit a wide array of dimensions, from 46.0 to 85.3 m (151 to 280 ft) in length and 8.8 to

FIG 6
A sonar mosaic with the wrecks outlined (J. Daniel).

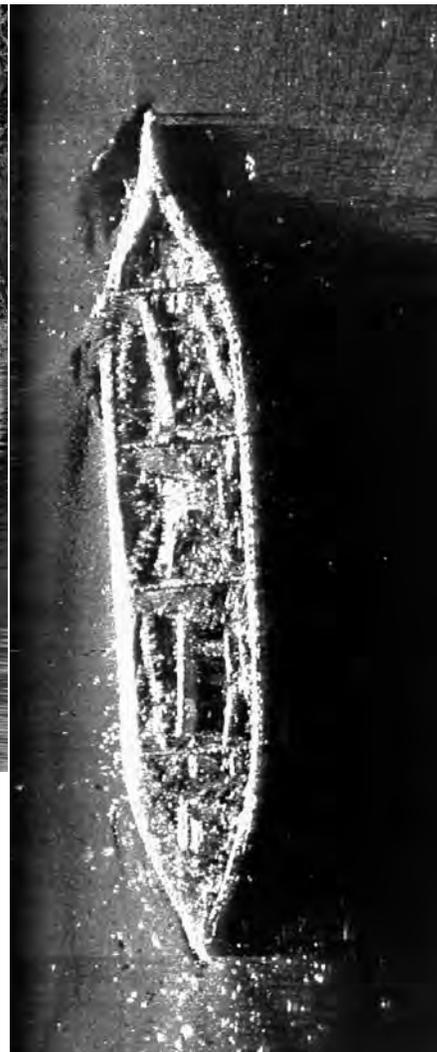


FROM LEFT

FIG 7
A partially salvaged iron or steel vessel. August 2011 (J. Daniel).

FIG 8
A sonar image of a potential EFC vessel. August 2011 (J. Daniel).

15.2 m (29 to 50 ft) in beam. The iron or steel vessel showed signs of partial salvage (Fig. 7). These vessels could represent any time period from English colonization to the modern period. However, the dimensions and design characteristics of some of the vessels are indicative of one particular time period in American history. The contracts for steamships built for the EFC during World War I outlined many specific details, including a length between perpendiculars of 81.7 m (268 ft), a beam of 14.0 m (46 ft), four water-tight wooden bulkheads, and diagonal iron straps (Fig. 8).⁴⁴ The length and beam measurements of one of the City Point vessels match exactly those specified in the contracts. Four bulkheads were also identified in the sonar record, and photographs taken at low tide revealed diagonal straps between the outer hull planking and the frames (Fig. 9). This is not to suggest that all of the wrecks identified as ocean-going vessels were built under EFC contracts, but it is a possibility that some were produced for that purpose. Other wrecks in the tidal flat could represent ships, brigs, brigantines, schooners, or any other



type of ocean-going vessel used since this area of the James River was first settled by Europeans.

The size and shape of some of the vessels located during the City Point Shipwreck Survey suggest they were barges used in the late 19th and early 20th centuries for bulk transport (Fig. 10). A 1916 report to the U.S. House of Representatives states that this type of barge was called a “combination seagoing and inland barge,” because it was capable of handling the work of both types of vessel.⁴⁵ Combination barges could run along the coast, but they could also operate in canals due to their light draft and narrow beam. The report describes these barges as “about 200 feet long, 24 feet in beam, and having from 12 to 16 foot sides and no masts or motive power of their own.



They can carry about 500,000 feet of lumber or 900 tons of dead weight on a 9-foot draft, but considerably more when fully loaded to a 10 or 11 foot draft.”⁴⁶ They provided a cheap means of transportation, were built at a lower cost, could carry more on a lighter draft, were cheaper to operate compared to other open-water vessels, and could run in both open water and in small creeks and rivers.

Similar vessels were identified by North Carolina archaeologists Richard Lawrence and Mark Wilde-Ramsing and subsequently studied by students from East Carolina University in a ship graveyard near Elizabeth City, North Carolina. That investigation revealed that the combination barges ranged in length from 60.0 to 62.8 m (197 to 206 ft) with beams from 6.1 to 6.7 m (20 to 22 ft). The combination barges at City Point exhibit similar measurements, construction features, and hull shapes to those at Elizabeth City (Fig. 11).

Seeking proof of a possible Civil War association, three vessels along the DuPont wharf on the west side of the shipping channel were investigated

by Tidewater Atlantic Research archaeologists in 2009. These vessels were resurveyed in 2011 and are included among the 42 sonar targets. According to historical maps, this location was the site of the Civil War ordnance wharf. Diver reconnaissance identified rubber hose, galvanized pipe, and electrical wiring firmly associated with each wreck, suggesting an early 20th century context. Two proved to be the remains of steamships while the other was a tugboat. All had been salvaged of any machinery and were likely deposited after DuPont abandoned their Hopewell operations following World War I.

Conferences, Publications, and Further Research

The preliminary results of the 2011 City Point Shipwreck Survey were presented at the Society for Historical Archaeology annual meeting in Baltimore, Maryland in the Maritime Heritage Research session. The results of the survey have also been submitted for inclusion as a chapter

FROM LEFT

FIG 9
Diagonal iron straps located on the potential EFC vessel. August 2011 (J. Daniel).

FIG 10
A sonar image of an unknown vessel, an ocean-going vessel, at least two combination barges, and a partially buried rectangular barge. August 2011 (J. Daniel).

FIG 11
Diagonal ceiling planking
on a combination barge.
August 2011 (J. Daniel).



in *The Archaeology of Watercraft Abandonment: Ship Graveyards and Forgotten Fleets*.⁴⁸ Additional research for the 2012 season will be focused on archival investigations in Washington, D.C. and Norfolk, Virginia. Research at the National Archives will center on the Records of the United States Maritime Commission for details pertaining to the EFC and ship abandonment at City Point. The Records of the Office of the Quartermaster General will also be consulted for information about vessels abandoned at City Point during the Civil War. Historic maps and charts will also be reviewed at the U.S. Army Corps of Engineers, Norfolk District. The final goal of the 2012 season will be to conduct limited, non-destructive recording of selected wrecks accessible above water at low tide.

Conclusions

As part of the continuum of a rich and varied maritime heritage, shipwrecks in the James River have considerable historical and archaeological value. This ship graveyard presents an opportunity to study an assortment of ships from varying time periods, however, initial field and historical research suggest that most of these vessels were abandoned after two specific events: the Civil War

and World War I. The end of each conflict resulted in a flood of unwanted vessels.

The goal of the 2011 City Point Shipwreck Survey was to identify the number of ships present in the James River near City Point. The side scan sonar data revealed 42 shipwrecks. Beyond a mere inventory, the data provide a starting place for further archival and archaeological research. These vessels reflect the development of technologies created to meet particular needs and requirements, and the remnants of cargoes could illuminate the nature of both local and regional trade. The remains of these ships represent important elements of trade and transportation in the history of City Point, tidewater Virginia, and the United States.

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Notes

- ¹ Foster 1992, 58.
- ² Foster 1992, 66.
- ³ Tyler 1900, 130–1; Hagemann 1988, 21; Horning 2004, 34–5.
- ⁴ Tyler 1900, 130–1. The wreck of *Sea Venture* was excavated by Jonathan Adams, who is involved in INA’s ongoing excavation of the *Warwick*.
- ⁵ Tyler 1900, 130.
- ⁶ Horning 2004, 36.
- ⁷ Horning 2004, 44–5.
- ⁸ Watts 1998, 21.
- ⁹ Kennedy 1906, 6.
- ¹⁰ Horning 2004, 85.
- ¹¹ Watts et al. 2010, 16.
- ¹² Arnold 1932, 187.
- ¹³ Arnold 1932, 188.
- ¹⁴ Palmer 1884, 247.
- ¹⁵ Palmer 1884, 247.
- ¹⁶ Palmer 1884, 329.
- ¹⁷ Emmerson 1947, 12.
- ¹⁸ Watts 1998, 37.
- ¹⁹ Ritchie 1818, 1.
- ²⁰ Bullis 2011, 35.
- ²¹ Watts et al. 2010, 17.
- ²² *The Times* quoted in Watts et al. 2010, 17.
- ²³ Watts et al. 2010, 21–5.
- ²⁴ Livermore 1920, 337–8.
- ²⁵ Horning 2004, 116–7.
- ²⁶ United States Secretary of War 1866, 589.
- ²⁷ United States Secretary of War 1866, 589.
- ²⁸ Watts et al. 2010, 37–8 citing C. L. McAlpine to Wentz, letter, August 10, 1864, Record Group 92, Entry 1622, National Archives, Washington, D.C.
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- ³⁰ *The Sun* 1864, 1.
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- ³³ The United States Congress 1984, 8.
- ³⁴ Watts 1998, 48.
- ³⁵ Horning 2004, 147; Watts et al. 2010, 52.

- ³⁶ Watts et al. 2010, 54.
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- ³⁸ Shomette 1994, 48.
- ³⁹ *The American Marine Engineer* 1920, 30.
- ⁴⁰ Watts et al. 2010, 54.
- ⁴¹ Kiernan 1975, B1.
- ⁴² *The Washington Post* 1975, 106.
- ⁴³ Huggett 1989, 417; Virginia Department of Health 2012.
- ⁴⁴ Ferris 1917.
- ⁴⁵ United States House of Representatives 1916, 20.
- ⁴⁶ United States House of Representatives 1916, 20.
- ⁴⁷ Smith 2010.
- ⁴⁸ Richards and Seeb, in press.



CLOCKWISE FROM TOP LEFT

PLATE 1

Two divers check the lifting straps as another fills three lift bags with air in preparation for moving an enormous boulder from the crevice at the Bajo de la Campana site. Project director Mark Polzer captures the procedure on video. June 2011 (S.H. Snowden).

PLATE 2

Team members Staci Willis (left) and Laura White (right) paint a metric photography square that will be used to map small objects on the seabed. June 2011 (S.H. Snowden).

PLATE 3

Divers begin their ascent from the safety stop to the dive boat waiting on the surface after having completed another excavation dive on the site. July 2011 (S.H. Snowden).

PLATE 4

A young octopus, which the team nicknamed 'Coco,' peers out from the small dipper juglet in which it has taken up residence amid a jumble of pottery fragments in the crevice. July 2011 (S.H. Snowden).

PLATE 5

Close-up of a composite bronze and lead pan-balance weight raised early in the season from the deeper portion of the site. July 2011 (S.H. Snowden).





FROM FAR LEFT

PLATE 6
Michael Jones and
Rebecca Ingram excavate
the last in-situ plank of
YK 11. November 2008
(Y. Aydođdu).

PLATE 7
YK 14 during excavation.
April 2007 (M. Jones).





ABOVE LEFT TO RIGHT

PLATE 8

Marilyn Cassedy and Orkan Köyağasioğlu with Drum 1 (J. Littlefield ©INA).

PLATE 9

Six marble drums from the Kızılburun column wreck loaded safely on board *19 Mayıs*, surrounded by most of the people who helped get them there (J. Littlefield ©INA).

LEFT

PLATE 10

The remaining Kızılburun marble column parts were delivered to the courtyard of INA's Bodrum Research Center in June 2011 (M. Cassedy ©INA).



ABOVE

PLATE 11

Looking downstream from Eagle Rock toward the *Columbian* Slough. 2011 (R. Woodward)

FACING PAGE TOP RIGHT

PLATE 12

Anchored over the *Warwick* wreck site, Bermuda.

FACING PAGE BOTTOM LEFT TO RIGHT

PLATE 13

Recording a cannon, Project *Solebay*.

PLATE 14

Recovery of *Solebay* artifact.







TOP

PLATE 15

The *Ertuğrul* exhibit in Alanya, 16 May to 18 June 2012 (B. Lledó).

ABOVE FROM LEFT

PLATE 16

Student from Wakayama, Ms. Kaizu, removes concretions from an artifact (B. Lledó).

PLATE 17

The *Ertuğrul* cooking pot, considered the symbol of the shipwreck (B. Lledó).



PLATE 18
John Pollack (INA) setting up the total station in Duong Giang (R. Sasaki).



FROM TOP

PLATE 19

The 2011 Bạch Đằng Survey Team (R. Sasaki).

PLATE 20

Basket boats in varying shapes and sizes are common sights along the Vietnamese shoreline (C. Palmer).

PLATE 21

Grouping of round Vietnamese basket boats (C. Palmer).





Berta Lledó

University of Alicante Ph.D. Candidate/
INA

Berta Lledó is a Spanish archaeologist specialized in Islamic glass. She started collaborating with INA in 1993 when George F. Bass asked for volunteers worldwide to help with the study of the Serçe Limanı Glass collection. Now she is a co-author on the final publication. Since that time she has lived in Bodrum and has participated in many INA projects in Turkey. At the moment, Berta is enrolled in a Ph.D. program and is the archaeologist of the *Ertuğrul* Project, an INA excavation of a Turkish shipwreck in Japan.

Frigate *Ertuğrul* Project 2011

OVERVIEW

During 2011 there was no excavation at the submerged site of the frigate *Ertuğrul* off the island of Oshima, Japan. Nevertheless, it was one of our busiest years since the beginning of the project in 2007. Our archaeological work focused on laboratory work and research, both in Bodrum, Turkey and Kushimoto, Japan. Simultaneously, we continued to improve the contents of the *Ertuğrul* Traveling Exhibit, which started in Mersin in 2010 and was displayed for six weeks in May and June 2011, in Alanya, (Plate 15—p. 70/71) one of Turkey's most visited ancient landmarks, and later in October at the Osaka Maritime Museum in Japan (Fig. 1).



RIGHT

FIG 1

Ertuğrul exhibit in Osaka
Maritime Museum
(B. Lledó).

JANUARY-FEBRUARY 2011 Conservation in Kushimoto, Japan

January and February 2011 were spent in the town of Kushimoto, where most of the artifacts from the excavation still remain. The Kushimoto municipality provided us with work space in the center of town, easily accessible by volunteers who came in the afternoons to help process the objects.

We counted on the help of two permanent lab assistants, Mrs. Higashiji Yukari and Mr. Daisuke Torikai, who, besides working with the objects, acted as translators, allowing me to communicate with the rest of the volunteers at the lab.

During the six weeks the lab was open to the general public, Mrs. Eiko Kubo, a senior citizen, came almost every day, as in previous years, contributing greatly not only to the mechanical cleaning of the artifacts, but also to our integration into the town's traditions and dynamics (Fig. 2).

The municipality often organized visits to the lab for people from other cities, such as Osaka, Wakayama and Tanabe, especially visits by regional education

FIG 2
Kushimoto citizen Mrs. Kubo
works in the lab cleaning
Ertuğrul nails (B. Lledó).



council members or university students of history and archaeology (Fig. 3; Plate 16–p. 70). These visits took place mostly on weekends, since most of the visitors, even when coming from official offices, used their free time to volunteer. During the week, local high-school students came with teachers as part of their history classes, as has become a tradition since 2009. Mechanical cleaning of artifacts, such as nails, bullets, lead fragments, glass and porcelain and dismembering small concretions and other tasks, were all accomplished thanks to the work of a dozen volunteers (Fig. 4).

At the end of February 2011 we closed our lab in Kushimoto and returned to Turkey, where we continued library research, including at the Tooze Library in Bodrum INA headquarters, studied the artifacts in INA's Nixon Griffis Conservation Laboratory also in Bodrum, and concentrated on drawing and photographing materials like porcelain and glass.

Our research focused on building up a database of information on each

artifact recovered from the wreck, especially searching for new sources of information.

16 May to 18 June 2011: *Ertuğrul* Traveling Exhibition in Alanya, Turkey

March through May was devoted to the preparation of displays for the *Ertuğrul* exhibit in Alanya. It was an exciting challenge, especially because of the exhibit's location: Alanya's medieval Kızılkuş (Turkish for Red Tower) (Fig. 5).

Kızılkuş, a restored octagonal tower built in the 13th century, is part of the impressive medieval city walls of Alanya and it is situated at the end of the peninsula where the citadel is located. It is in the center of the historic town's walking paths and attracts hundreds of visitors to temporary exhibits held in its overwhelming setting.

It is the most prominent landmark in this highly touristic city. Its restoration is part of an



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FIG 3
High school students came to the lab regularly with their history teachers (B. Lledó).

FIG 4
Lab assistant Ms. Yukari cleans some bullets covered in concretions (B. Lledó).

FIG 5
Kızilkule (Red Tower), part of the 13th-century Alanya city walls hosted the *Ertuğrul* Exhibit (B. Lledó).

admirable program of historical and archaeological work carried out over the last 20 years by the Municipality of Alanya. Recently added to the list of accomplishments is the restoration of the 13th-century dockyard adjacent to the tower.

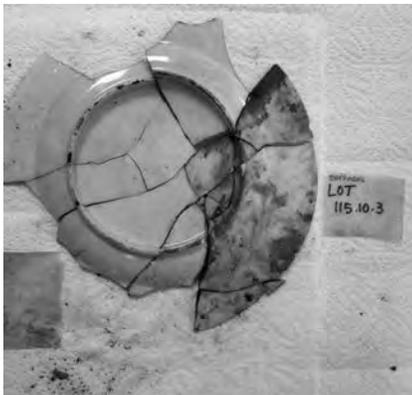
With the Kızilkule plans in hand, I set to work on the design of display cases and information panels that would also suit the architecture of this historic building. The octagonal tower of Kızilkule is organized in five floors. The exhibit hall, located on the bottom floor, is dominated by a central cistern, an octagonal vertical structure which would have provided water in case of an enemy siege. The surrounding open floor space is divided into eight lateral niches, which perfectly accommodated our themed exhibits and provided a suitable areas for video shows.

I created a set of 37 information panels in Turkish to accompany the *Ertuğrul* artifacts. Sixteen of the panels were placed over the horizontal display units specially built for the occasion, giving precise information

about the artifacts displayed. Seven others were used to introduce the project (one of them for children), and the remaining 14 panels covered the walls of the central cistern to illustrate *Ertuğrul's* voyage with first-person quotes from the sailors' letters and diaries.

The Municipality of Alanya sponsored the printing of a 50-page color catalog of the exhibit and an eight-page activity book for children about the *Ertuğrul* shipwreck, which was set in a special section of the exhibit for young visitors. In this space, children could watch an animated video of the *Ertuğrul* story and complete a number of activities. This was an especially popular area during school visits organized by the Education and Cultural departments of the local government.

The municipality also sponsored the production of three short video programs shown in different areas of the exhibit: "Underwater Excavation of the *Ertuğrul*," "Work at the *Ertuğrul* Research Center, Kushimoto, Japan," and "The Story of



Ertuğrul,” a narrated version of Tufan Turanlı’s children’s book, all of which were prepared in Bodrum between March and April and are now available online.¹

July–Aug 2011: Nixon Griffis Conservation Laboratory, Bodrum, Turkey

In July and August, Ms. Andrea Azuar Toro, a senior student of the conservation and restoration program at Valencia Polytechnic University in Spain, worked with *Ertuğrul* artifacts in the Nixon Griffis Conservation Laboratory, at INA’s Bodrum Research Center (Fig. 6). Under the close supervision of INA Bodrum Research Center laboratory staff, Ms. Toro’s primary focus was key artifacts that needed immediate attention due to their imminent return to Japan; in October 2011, the Maritime Museum of Osaka was to hold the first display in Japan of the *Ertuğrul* Traveling Exhibit.

One of Ms. Toro’s jobs was removing the last small concretions from the large *Ertuğrul* cooking cauldron and carefully checking its surface to ensure that the state of preservation was satisfactory. This impressive object, measuring approximately 80 cm in diameter, 47 cm in height, and weighing almost 50 kg, is by far the largest artifact recovered from the wreck site. It has become something more than a galley utensil; it has become the symbol of the collective effort and sacrifice that is epitomized by the *Ertuğrul* shipwreck (Plate 17–p. 70).

Half visible on the seabed for more than 120 years, this large cooking vessel, together with its lid, was preserved almost intact on the site. Only one of the handles was not found in situ, having been removed in the 1970s and safely exhibited in the *Ertuğrul* Museum in Kashino on Oshima Island, Japan.

The massive body of the cauldron

was made from a single strip of copper formed into a cylinder and joined to the bottom that was made from a separate, circular piece of copper. The two pieces of copper overlap and it is likely that a mixture of heated powdered brass, zinc, and lead called tenakar² was used to join them. The joints were secured by the application of rivets every 4 cm. It is likely this cooking pot was lined with tin, although none of the lining is preserved. Its approximate volume, 198 liters, would provide 609 portions of 325 cc each—adequate rations for the *Ertuğrul* crew of 609 sailors.

Ms. Toro’s second task was to work with a group of very delicate porcelain fragments extracted in the lab from concretions that showed a high content of iron oxide. The white-decorated porcelain fragments originated in Yokohama, and had dark iron stains on their surfaces. Their careful cleaning was a painstaking job since remains of fragile paint and gold highlights still remained under the stains. Nevertheless, hours of determination was paid off by an almost complete plate reconstructed from 12 fragments (Fig. 7). The few missing fragments will hopefully be recovered in some of the concretions still to be cleaned. Thus far, this plate is the only example of Yokohama porcelain in the *Ertuğrul* collection with partially preserved blue and gold paint.³

Also during her internship, Ms. Toro and I worked together to make a replica of another popular piece in the collection—a small glass perfume bottle recovered from the wreck—using silicon molding and epoxy resin (Fig. 6). The replica will be exhibited in both Turkish and Japanese museums.

During the summer months, working in parallel with the conservation, we redesigned the exhibit panels for the display in the Osaka Maritime Museum, adding updated English and Japanese text to

all of them. The Japanese translations were done in collaboration with the Osaka Maritime Museum curators, while the graphic work was prepared in Bodrum (Fig. 8).

By the end of September the artifacts exhibited and conserved in Turkey were ready to travel back to Japan. The collection was freshly inventoried, photographed, and packed in preparation for the opening of our first show of the *Ertuğrul* Project Traveling Exhibit in the fantastic Osaka Maritime Museum, Japan (Fig. 9).

4 Oct–6 Nov 2011: *Ertuğrul* Traveling Exhibition in Osaka, Japan

Working closely for two weeks in a museum of this quality, with its welcoming staff, was a wonderful and unforgettable experience. The building itself is an amazing feat of engineering and was the 2001 winner of the Structural Special Award from the United Kingdom's Institution of Structural Engineers.⁴ A four-story circular structure provides open exhibit areas and permanent exhibit halls around a central open space occupied by a full-size replica of the 30 m, 17th-century merchant ship, *Naniwa Maru*, which appears to be waiting for the wind to fill its open sails.

The design of the museum gives the visitor a rare opportunity to see *Naniwa Maru* from every possible angle, even from above, for the structure is a glass dome over the sea, accessible only by an underwater tunnel from the visitor's center on land (Fig. 10).

The *Ertuğrul* exhibit, titled for this occasion, "Bringing Back Memories of the Frigate *Ertuğrul*, Bond between Japan and Turkey," was located in a large space reserved for temporary exhibits (Figs. 11 & 12). Lectures and

related events were organized over weekends and, according to museum records, visits increased by 20% over the course of the exhibition.

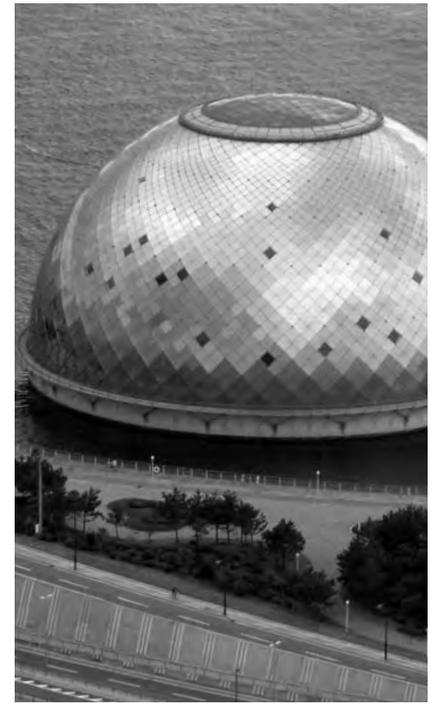
The *Ertuğrul* Traveling Exhibit will be in Wakayama Prefectural Museum in September 2012. Negotiations with museums in Tokyo, Yokohama, and Kobe are ongoing since future exhibit dates for those museums have yet to be decided.

The exhibit in Osaka gave us an opportunity to do further laboratory work in Kushimoto at the end of 2011, at minimal cost.

It also allowed us to participate in the local cultural week (20–25 October 2011) for which we were asked to prepare a small exhibit of the project to share the importance of underwater heritage and the role of local involvement in the project. As George F. Bass mentioned in a recent interview for *Discover Magazine*, "Every one of these shipwrecks we excavate is possibly a site of terrible human tragedy."⁵ *Ertuğrul* was one such site—most importantly, a contemporary archaeological site with special historical, social and humanitarian meaning to the people of both Turkey and Japan.

We should not forget that this ship traveled 11 months to honor the Japanese Emperor on behalf of the Ottoman Sultan. After 540 sailors lost their lives upon completing this mission, the Oshima Island fishing community took care of all 69 survivors. These events have created a deep bond between the two countries and instilled a sense of pride in the people of both nations for their ancestors. After visiting the exhibit in Osaka, one Japanese visitor said she felt touched and 'as close as family' to the Turkish people.

The *Ertuğrul* traveling exhibit guest book has collected hundreds of testimonials that will further help us understand the impact of this public outreach. Through the four exhibitions



FACING PAGE FROM TOP

FIG 6
Andrea Azuar Toro making a silicone cast of the *Ertuğrul* perfume bottle (B. Lledó).

FIG 7
One of the Yokohama porcelain plates cleaned and reconstructed in Nixon Griffis laboratory during the summer 2011 (B. Lledó).

FIG 8
Printing and preparing the exhibition panels in Mahmut's workshop in Bodrum (B. Lledó).

FIG 9
All the artifacts conserved and exhibited in Turkey were packed and ready to go to Osaka, Japan (B. Lledó).

ABOVE

FIG 10
Osaka Maritime Museum. A glass dome over the sea, accessible by an underwater tunnel from the visitor center on land (B. Lledó).

FIG 11
The author positions artifacts in the display cases of the Osaka Maritime Museum (A. Turanli).

FIG 12
Ertuğrul exhibit in Osaka Maritime Museum (B. Lledó).



held to date, the *Ertuğrul* shipwreck story has touched many of its visitors and has also demonstrated how underwater archaeology can be used as a tool of cultural exchange and even to further international relations.

The following are statements collected by the Osaka Maritime Museum visitor survey:

“This exhibit was a very important opportunity to re-discuss the partnership between the two countries.”

“I am surprised that until now, there has never been such an underwater excavation project even though Japan is a country surrounded by the sea. I’m becoming interested in other remains of shipwrecks around Japan.”

“We know about the friendly relations between Turkey and Japan, but most Japanese don’t know why or how to build strong bonds between the two countries. Japanese have to pass knowledge of this incident down to next generation.”

We hope that the *Ertuğrul* traveling exhibit will continue fulfilling its mission in the future, spreading knowledge and excitement to the visitors.

Acknowledgments

We extend our special thanks to the Kushimoto Municipality and the people of Kushimoto for their unconditional support; the Osaka Maritime Museum and its staff, especially Fujimoto-san and Tanahashi-san, with whom we worked closely in preparing the exhibit. We would also like to thank the Institute of Nautical Archaeology and the staff of INA’s Bodrum Research Center in Turkey, Tuba Ekmekçi and Özlem Doğan, and the personnel of INA’s Nixon Griffis Laboratory in Bodrum for their constant support and advice. We are most grateful to Kimberly Rash, Interim Head Conservator of the Griffis Laboratory, 2010 and

2011, who still helps us as an advisor and consultant, as well as conservator Esra Altınanıt from INA’s Bodrum Research Center, for her advice and help with the conservation challenges we encounter. Also, we thank BOSAV, a local Bodrum cultural foundation, for their support of the project in Turkey.

My heartfelt thanks goes to Dr. George F. Bass, who first invited me to work with INA and has always kindly supported my research and writing.

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Notes

¹ Available on www.youtube.com as “An Ottoman Shipwrecking Japan: The Ertugrul Frigate”.

² A traditional mixture commonly used in copper work in Ottoman times and even today.

³ For details about this type of porcelain see Lledó and Turanlı 2009, 80–92, and Lledó 80–88.

⁴ For details about the Osaka Maritime Museum see the official website: <http://www.jikukan-ogbc.jp/english/index.html>; for more about the museum structure, see the builder’s website: http://arup.com/Projects/Osaka_Maritime_Museum.aspx

⁵ Powell 2012.



Randall Sasaki, M.A.
Texas A&M University Ph.D. Candidate/
INA

Randall Sasaki is currently living in Japan and conducting research on traditional East Asian shipbuilding technology. His previous research includes the timber analysis at Takashima Underwater Site, a Mongol invasion shipwreck site where Kublai Khan's fleet was destroyed by a legendary typhoon (Kamikaze). He has written articles and books in both Japanese and English; his book, *The World-History Based on Shipwrecks* (Japanese), is the best selling title in the genre of Nautical Archaeology in that country.



Jun Kimura, Ph.D.
Adjunct Lecturer Flinders University/INA

Jun Kimura is a maritime archaeologist and an Australian Research Council Post-doctorate Fellow. He completed a Master of Maritime Archaeology at Flinders University in South Australia in 2006. His Ph.D. was awarded in 2011. His expertise is East Asian shipbuilding traditions developed in the Yellow Sea, East China Sea, and South China Sea. His interest also includes underwater cultural heritage management in Japan and protection and management of Japanese shipwrecks in other Asia-Pacific countries.

ARCHAEOLOGICAL SURVEY AT THE

Bạch Đằng Historical Battlefield

Introduction

The Institute of Nautical Archaeology (INA) has been involved with archaeological work at the sites along the Bạch Đằng River in Vietnam since 2008.¹ This is the naval battlefield where the invading Mongol fleet was destroyed by Vietnamese forces in 1288. Legends tell us that the Vietnamese General Trần Hưng Đạo secretly set wooden stakes along the Bạch Đằng River and waited for the retreating Mongol fleet to pass through the area. Relying on the falling tide, General Hưng Đạo trapped the enemy fleet with the wooden stakes and defeated the world's largest naval force at the time. Despite the historical significance of this event, no archaeological remains from the battle have been recovered except wooden stakes scattered in the area where the battle took place. A series of INA field projects led by Randall Sasaki and Jun Kimura has focused on the excavation of one of the major stake fields at Dong Ma Ngua (DMN) fish pond and the reconstruction of the battlefield. This year's project, which took place in late November 2011, is a continuation of the research at the Bạch Đằng River sites. The project was supported by INA in cooperation with the Maritime Archaeology Program at Flinders University and the Institute of Archaeology at Hanoi.

The 2011 survey had four major objectives. First, we completed a cartographic survey to define the research area. Second, we conducted remote sensing surveys using a metal detector, gradiometer, Ground Penetrating Radar (GPR), and side scan sonar systems on both land and water, including canals, fish ponds, and rivers. Third, we collected sediment cores for analysis; interpretations so far have shown excellent results.

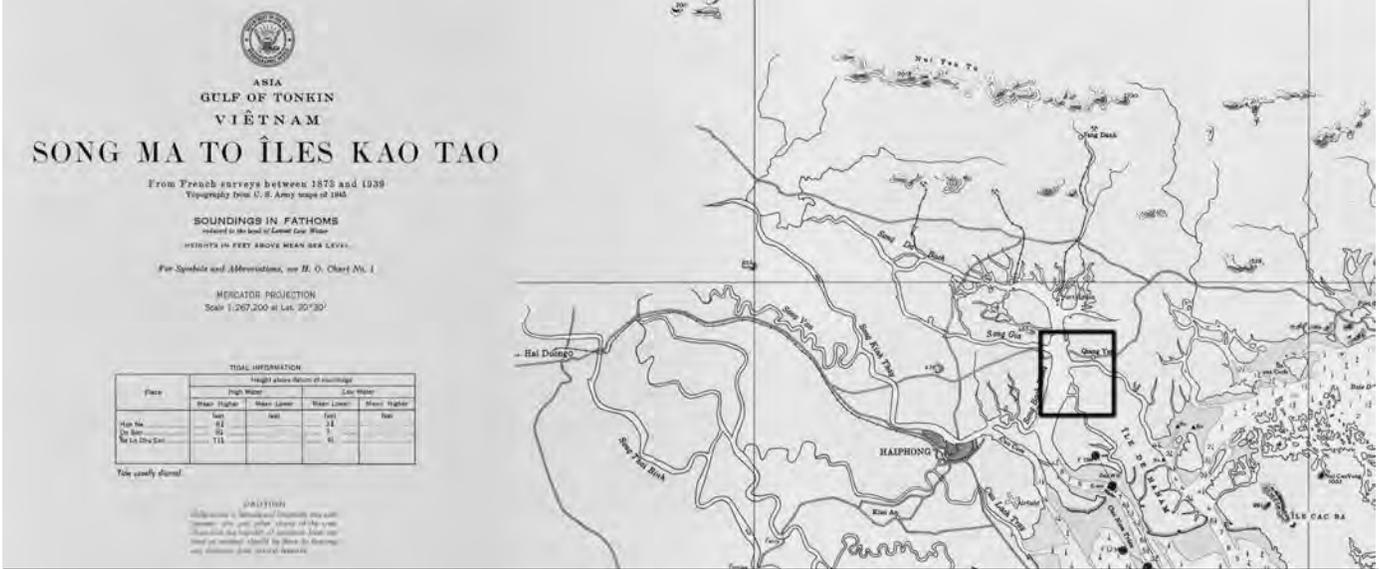
Finally, we interviewed local residents with hopes of obtaining information regarding the possible position of stakes, to have a better idea of the past landscape and to collect surviving legends regarding the battle. This report outlines the survey methods we used, and discusses some of the results we obtained from the data analysis.

Description of the Area & Cartographic Survey

The project area is located within a small portion of the Red River delta system that is dominated by the Bạch Đằng River, and smaller Chanh River, along with several other minor tributaries, all of which flow into Ha Long Bay (Figs. 1a & 1b). These rivers move large volumes of sediment eastward from the central highlands down to the coastal plain where they are deposited as broad, flat, low-lying landforms during the flooding associated with the South Monsoon. Although most of the area we surveyed is on firm land today, it was not so in the past. Seven hundred years ago the region was an estuary environment with islands and small and large streams.



FIG 1a
Map of Vietnam
(R. Sasaki).



FROM TOP

FIG 1b

A navigational map near the research area with the box indicating the approximate extent of the site (U.S. Army Map of 1945).

FIG 2

A satellite image showing area surveyed in 2011 (J.B. Pelletier).

0 112.5225 450 675 900 Meters	CLIENT Institute of Nautical Archaeology PROJ Battle of Bach Dang Field Season 2011 REVISION NO 0 DES BY JBP 00/00/00 SCALE 1:18,000 DR BY xxx 00/00/00 CHK BY XX 00/00/00		TITLE Geophysical Project Survey Areas (Base Map 2003) Colored Lines Denote Survey Areas Yen Hung District Quang Ninh Province
Source: IntraSearch, Inc 5340 South Quebec St, Suite 300s Greenwood Village, CO 80111	PROJ NO 111911-112811 FIGURE 1		

The survey area targeted in 2011 was approximately 560 m by 1,000 m. This area includes two smaller target areas named Duong Giang and Dong Ma Ngua. The first target, Duong Giang, was identified as an area of potential interest during the 2010 survey when local residents reported the existence of an area called

“Shipwreck Place” (mound). As such, the survey team considered there to be a high likelihood of locating ship remains on the site. The second target, Dong Ma Ngua (DMN), is located south of Duong Giang. During the excavations in 2009 and 2010, 55 stakes were identified at a fish pond in the DMN area. Based

on these findings, we presumed that in these two target areas there would be an excellent opportunity to collect reliable environmental data, find more stakes, and perhaps discover artifacts related to the battle. The survey area was further partitioned into smaller blocks (Fig. 2). These blocks included the agricultural fields adjacent to the

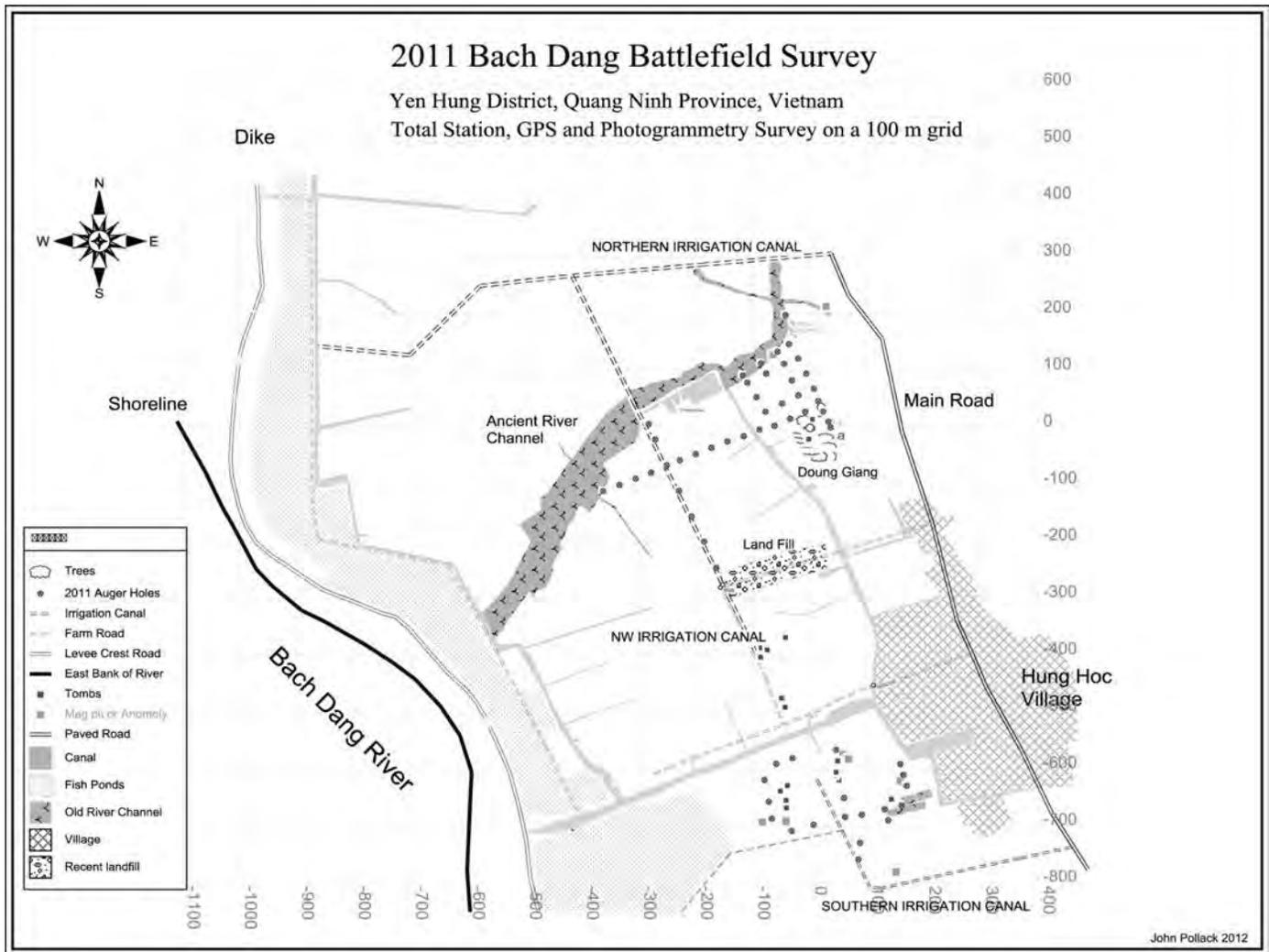


FIG 3
A cartographic map of the surveyed area (J. Pollack).

“shipwreck mound” at Duong Giang, a field west of the Old Kanh River canal, Old Kanh River canal, east and west fields of DMN, the fish ponds at DMN, and east and west fields of Hai Yen Ditch.

The objectives of the cartographic survey were to prepare an accurate map of the study areas integrated with remote sensing data and to leave a series of benchmarks for future work. The 2011 plane survey work was accomplished utilizing a Nikon NPR-362 total station for precise surveying, and a set of Garmin handheld GPS units to provide tracks and locations of larger features within the study area (Fig. 3). The total station was used to run a transect consisting of 11 benchmarks from the 2011 datum to the 2010 datum at the fish pond, approximately 660 m to the south. Approximately 400 radial

survey measurements were taken from the various benchmarks, to accurately locate features such as houses, roads, irrigation canals, power poles, and the GPR surveys and auger holes. Precise elevations were also obtained at each auger hole and a number of other locations during the survey. A combination of total station, GPS and satellite imagery was used to delineate the general position of the waterways in the study area. Using the above mentioned strategies, an accurate plan view of the 2011 study areas was produced. The elevation control established over the site will be useful in interpreting these and other data in our continuing analysis (Plate 18–p. 71).

Metal Detector Survey

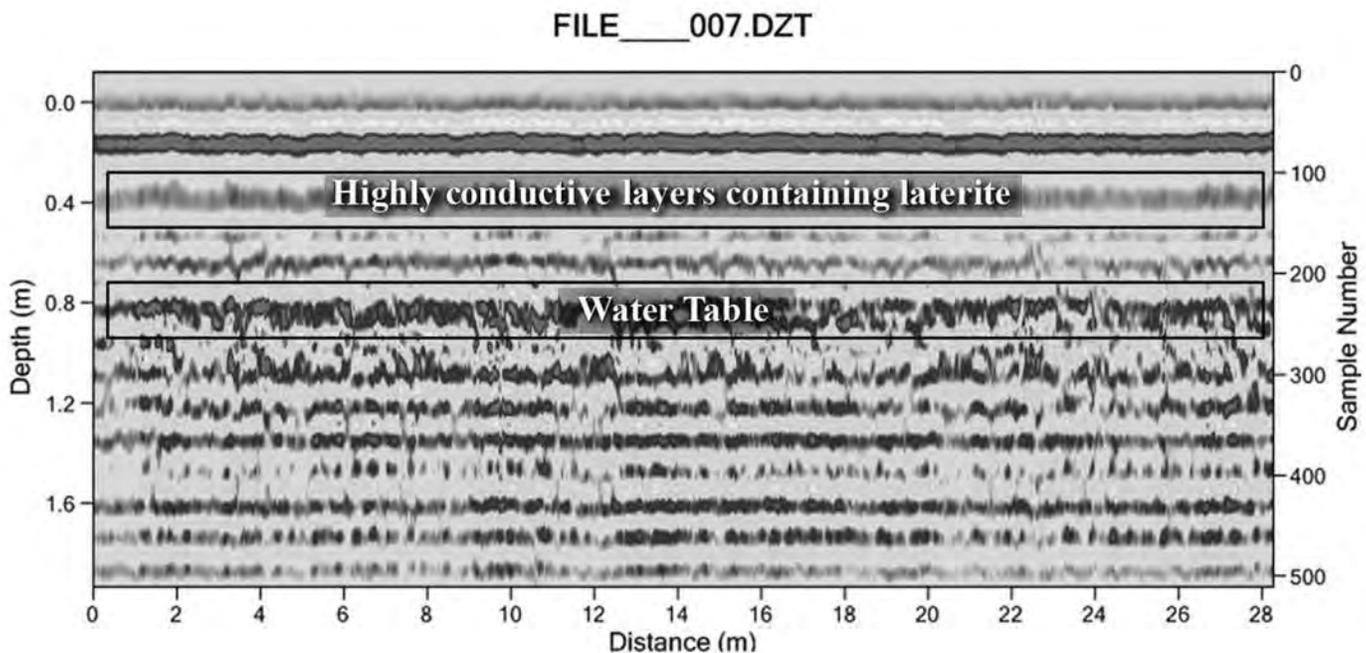
The VLF (5.5 kHz) metal detector was utilized in both single and dual

antenna configurations in the field east of Duong Giang. During the initial calibration of the system, it became apparent that significant soil anomalies were masking signals. These anomalies were subsequently identified as undeveloped lateritic soil horizons or inclusions that unbalanced the threshold setting of the metal detector, rendering the detector blind. In this region, lateritic soil develops during the wet season of the monsoon cycle when meteoric water leaches humic acid from upper soil horizons and carries it down into the substrate, where it attacks the parent bedrock (in this case, limestone). Limestone weathers to several clay minerals

including kaolin, and can precipitate and deposit metallic minerals, such as hematite, goethite, and other iron oxides. Weakly developed lateritic soil was recorded throughout the survey areas as minor horizons of red (iron oxide) stained soils or disseminated masses within the soil structure. After several attempts to balance or adjust the sensitivity of the instrument, it was determined that this was not an appropriate technique for the regional soils and that a multi-frequency machine should be tried in the future. No further work was attempted with the metal detector.

Ground Penetrating Radar (GPR) Survey

The GPR surveys were conducted using a GSSI SIR 3000 GPR control unit with a 400 MHz antenna. From the start of the survey, it became apparent that the radar was not generating favorable results. In order to identify the cause, it was decided to create a test plot in which to determine how well signals were propagating through the ground. This involved digging a hole 60 cm deep and 1 m long, and installing a 16 mm thick steel bar. The hole was then backfilled, slightly compacted and then traversed with the GPR perpendicular to the bar in an attempt to image it effectively.



Unfortunately little to no reflections from the steel bar at 60 cm depth were visible in the data, illustrating that the frequency of the antenna being used was unlikely to be effective in the detection of archaeological materials. Many factors limited the effectiveness of GPR within the paddy fields. Radar signals (Fig. 4) were attenuated by the layers of aforementioned laterite and the area's silty clay soil while a high water table and high salt content limited signal penetration.

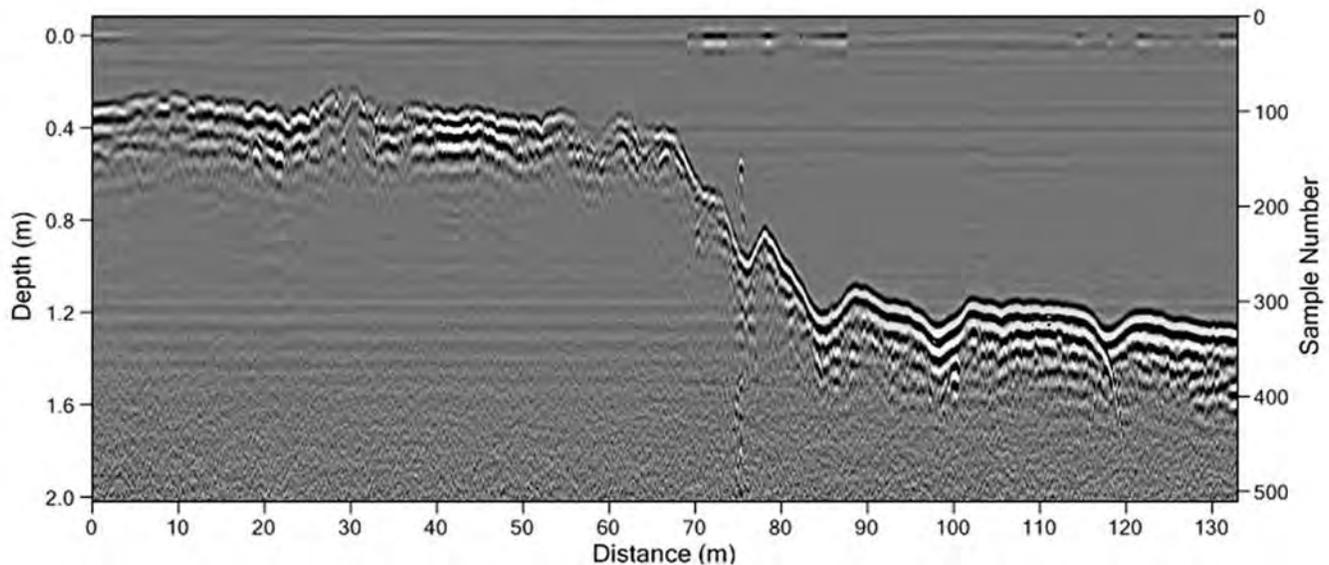
As the use of a 400 MHz antenna

was demonstrated to be ineffective to detect stakes or shipwreck remains in this particular setting, it was decided that a lower frequency antenna may be better suited to the conditions present at our site. We believe a low-frequency system will be useful for mapping the old river system to determine where the battle was fought though unfortunately ineffective in detecting archaeological remains such as the wooden stakes. The trade-off between depth of penetration and resolution in terms of radar frequency, is that

FIG 4
GPR data (D. Ross).



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the lower the frequency, the deeper the penetration, and the higher the frequency, the greater the resolution. Typically low frequencies are used to detect geological features, such as paleo-channels and bedrock.

During the 2011 survey, the GPR unit was also used over water as a basic sub-bottom profiler placed flat in the bottom of a boat (Fig. 5a & b). In order for a GPR signal to propagate well, the water needs to be salt-free. In all sections surveyed, the GPR signal propagated through the water better than expected. In areas of high mineral deposit, however, little-to-no penetration was observed. These deposits were indicated in the GPR

data by strong reflections and signal “ringing” throughout the profile. Many anomalies were detected on the bottom of the waterways, and just below the mud surface. None were strong enough to indicate the remains of a hull, but some could be consistent with the possible reflection of a stake if it were sticking out of the mud (Fig. 6). Reflections detected beneath the river bottom surface are unlikely to be from organic remains, in as much as mud and wood have little dielectric contrast in this particular environment and are therefore invisible to GPR.

Gradiometer Survey

The gradiometer survey showed the

greatest potential for subsequent surveys. Although numerous anomalies were found in all fields, only a few selected anomalies will be discussed here. The survey was operated in a manner that minimized interference by random magnetic point sources. The data recorders were interfaced into a GPS system to ensure proper integration of information while maintaining sub-meter positioning. A Trimble AG132 differential global positioning system (DGPS) was used for survey navigation. A Geometrics G858 magnetometer operated in gradiometer mode was used to determine the presence of magnetic

anomalies which might indicate stake yards, shipwrecks and other features (Fig. 7). Data were analyzed with Golden Software's Surfer 9.0, and ESRI ArcView 9.3. Magnetic perturbations of 3 nT or greater with durations greater than 1 m were cataloged for further analysis. A total of 116 magnetic perturbations were enumerated and reviewed.

Several criteria are typically used to evaluate anomalous magnetic data to properly distinguish between naturally occurring anomalies and those of potential cultural significance. In order to assess and perhaps to identify the source of magnetic anomalies, it was decided to open small test pits (no larger than 2 m by 1 m) where strong anomalies had been found. Three test pits (of no larger than 2 m by 2 m) in the east field of DMN were opened. Test pits 1 and 2 showed a slight discoloration in the soil, perhaps from a concentrated mineral iron deposit. Test pit 3 may have been an old grave; the soil appeared to be a "fill" and whitish-gray sand dominated the profile. Some organic remains were also found. Three test pits were also opened in the west field of DMN (Fig. 8). These pits all had rich organic top soil. A number of 19th-20th century ceramics and one iron nail were found. These artifacts were detected no deeper than 50 cm from the surface; perhaps they are trash pits from the recent past. None of these test pits proved to be of the period of the battle and all were thus excluded from the list of anomalies. To identify the anomalies, a full excavation has to be designed in the near future.

In order to assess the potential identity of these magnetic anomalies, assumptions had to be made regarding the construction of the ships, based on data collected from contemporary Chinese ship fragments belonging to the Mongol Fleet recovered from Takashima,

Japan, and other shipwreck sites.² The first assumption is that large amounts of iron fastenings were likely used on Chinese ships of the invasion fleet. The iron nails from Chinese ships of that era could measure about 35 cm in length and have a 0.8–1.5 cm² cross section, yielding a mass of iron between 200 and 500 g per nail. Planks were fastened with larger nails driven diagonally but overlapping planks were nailed directly to the hull using smaller nails, as seen in ships from Shinan and Quanzhou.³ Larger nails that held the planks together were spaced on average 15–20 cm apart. Using these data as a baseline, the weight of iron needed to connect two planks will be roughly 1.0–2.5 kg for a 1 m section. In addition to this calculation, corrosion levels must also be taken into consideration. A substantial loss due to corrosion is assumed during the seven centuries that have passed since the battle, while the preservation status of the iron nails would be dependent on environmental conditions and various other factors. The baseline of magnetic deflection as summarized by Breiner can be used to project the amount generated by a 20 m long vessel according to the depth at which it is buried using the minimized value of assumed iron remaining (100–500g).⁴ The 100 nT to 400 nT (3 m to 4 m) deflections would be recorded in the field. If the vessel were less than 20 m long the anomalies would be of similar amplitude and have a smaller duration.

During the gradiometric survey of the east field of Duong Giang we recorded 15 magnetic anomalies (Table 1 and Fig. 9). Of these, twelve are likely associated with modern structures (power poles, buildings, irrigation ditches, graves, and modern ferrous debris). There are two concrete pads (M5 and M11) from an earlier set of electrical transmission pylons located in the paddies, as well as five modern concrete pylons (M1 through M4 and M8) that cross the fields. The remaining three anomalies (M7,



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FIG 5a and b
GPR on a boat (R. Sasaki).

FIG 6
GPR data from waterway
survey (D. Ross).

ABOVE

FIG 7
Douglas Inglis (INA) using
gradiometer unit in the field
(R. Sasaki).

FIG 8
Test unit opened in the west
field of DMN (R. Sasaki).

Table 1 Anomalies from the East and West Fields of Duong Giang (M: Monopole, D: Dipole, and MC: Multi-Component)

Anomaly #	Magnetic Amplitude (nT)	Duration (m)	Magnetic Signature	Fe Mass (Kg) at -1m	Fe Mass (Kg) at -2m	Fe Mass (Kg) at -3m	Fe Mass (Kg) at -4m	Fe Mass (Kg) at -5m	Notes
M24	25.0	6.0	MC	0.42	3.32	11.21	26.58	51.87	Complex 3 Loci
M25	7.0	8.2	D	0.12	0.93	3.14	7.44	14.52	Possible Grave
M26	8.0	8.0	D	0.13	1.06	3.59	8.51	16.60	Possible Graves



FIG 9
5 nT contour line of the east and west fields of Duong Giang. The east field is marked by a white line (J.B. Pelletier).

M10, and M13) have better potential of being archaeological remains such as sunken vessels based upon the duration and amplitude of the signal. M7 is a 40 nT multi-component perturbation spread out over 13 m with the two primary magnetic centers of distortion (loci) spaced 2.5 m apart. The theoretical ferrous mass at a depth of 2 m is approximately 5.32 kg. This is within the potential limits for possible vessel components as explained above. Both M10 and M13 are dipolar perturbations within ranges of potential hull components, and the contours seem to indicate the existence of a compact mass. Although M15 shows very little amplitude (3 nT), the anomaly appears to be a series of small scattered ferrous materials in a somewhat rectangular shape, which leaves open the possibility that it is of non-modern origin.

A total of 11 magnetic anomalies were recorded in the west field of Duong Giang (See Table 1 and Fig. 10), of which two are clearly associated with power lines (M16 and M17). The majority of the remaining anomalies include five arranged along the west margin of the old Kanh River, which remains a canal, and three along the wooded mound. Some of the recorded anomalies have durations or magnetic amplitudes that are sufficient to represent a possible buried ship (M21, M26, and M27). However, it is more likely these may be associated with modern graves located throughout the mound to the east. Overall, the anomalies in the west field, if associated with hull remains, should be buried at a depth of no more than 3 m, because the hypothetical

iron mass will be larger than the assumed value. Only M18 and M21 appear to be closest to the proposed range for ancient hull remains.

The west field of DMN had 24 magnetic perturbations (Table 2 and Fig. 10). The majority (19) are arrayed around the burial mound that appears to be a continuation of the burial mound from the east field of DMN. Two areas with anomalous magnetic responses require further description. The first area is adjacent to the burial mound and consists of anomalies M58 to M62, which all have low amplitude deflections, relatively short durations and simple magnetic signatures, and would normally be classified as graves. However, it is noted that all of the anomalies are neatly aligned east to west and are spaced 7 to 8 m apart. No other anomalies display this linear nature with consistent spacing. The only other anomaly in the west field of DMN that has characteristics that could possibly be associated with a buried vessel is M78 located in the southwest corner. M78 has a 30 nT gradient shift, 15 m duration, and a relatively complex pattern of magnetic centers distributed within a somewhat rectangular distribution. Both of these areas should be further surveyed to better define the extent of the distortions and then test excavations will need to be carried out to discern the nature of these anomalies.

In addition to terrestrial survey, the gradiometer survey was conducted over water on both the eastern and western sections of the ancient Kanh River, as well as at the fish ponds located at DMN. There were five magnetic perturbations recorded in

Table 2 Anomalies from the West Field of Dong Ma Ngua (DMN); (M: Monopole, D: Dipole, and MC: Multi-Component)

Anomaly #	Magnetic Amplitude (nT)	Duration (m)	Magnetic Signature	Fe Mass (Kg) at -1m	Fe Mass (Kg) at -2m	Fe Mass (Kg) at -3m	Fe Mass (Kg) at -4m	Fe Mass (Kg) at -5m	Notes
M63	12.0	2.7	D	0.20	1.60	5.38	12.76	24.90	Possible Grave
M64	4.0	5.0	D	0.07	0.53	1.79	4.25	8.30	Possible Grave
M65	12.0	5.0	D	0.20	1.60	5.38	12.76	24.90	Possible Grave
M66	18.0	2.5	D	0.30	2.39	8.07	19.14	37.35	Possible Grave
M67	25.0	4.0	M	0.13	0.51	1.14	2.03	3.16	Possible Grave
M68	11.0	3.4	M	0.06	0.22	0.50	0.89	1.39	Possible Grave
M69	9.0	4.8	D	0.15	1.20	4.04	9.57	18.67	Possible Grave
M70	12.0	5.0	D	0.20	1.60	5.38	12.76	24.90	Possible Grave
M71	18.0	4.0	D	0.30	2.39	8.07	19.14	37.35	Possible Grave
M72	20.0	2.0	D	0.33	2.66	8.97	21.27	41.50	Isolated Unknown
M73	10.0	4.3	D	0.17	1.33	4.49	10.63	20.75	Possible Grave Oriented E/W
M74	14.0	8.5	D	0.23	1.86	6.28	14.89	29.05	Possible Grave
M75	25.0	4.1	D	0.42	3.32	11.21	26.58	51.87	Possible Grave
M76	12.0	6.0	D	0.20	1.60	5.38	12.76	24.90	Possible Grave
M77	45.0	6.0	D	0.75	5.98	20.19	47.85	93.37	Possible Grave
M78	30.0	15.0	MC	0.50	3.99	13.46	31.90	62.25	Circular Area Complex 3 Magnetic Loci. Unknown Domestic Scatter
M79	17.0	8.0	D	0.28	2.26	7.63	18.08	35.27	Isolated Anomaly Unknown
M80	8.0	4.8	D	0.13	1.06	3.59	8.51	16.60	Possible Grave
M81	175.0	3.2	D	2.91	23.26	78.50	186.08	363.11	Possible Grave

the eastern section of the Old River Canal. Of the five anomalies, one is clearly associated with the bridge and culvert located north of DMN; one is in association with a sunken bamboo boat (also identified during side scan sonar survey), and the remainder appear to be domestic scatters. None of the recorded anomalies have the high magnetic amplitudes, complex signatures or long durations associated with potentially buried vessels. Only five transects were run on the western section of the Kanh River Canal. Unfortunately faulty cabling corrupted the data collected during the three days we had to complete the survey of this area. The anomalies here are distributed along the margins of drainage ditches and the raised terrace. Given the minor survey coverage for this large parcel, the distribution of these anomalies has

no statistical meaning. This area may be surveyed again when the research team returns to the area.

The survey at the DMN fish ponds, partially excavated in 2009 and 2010, showed interesting results. There are three magnetic disturbances recorded in the fish pond centered in the approximate area of the recorded stakes. The anomalies all have very low amplitude shifts of 2 to 3 nT with simple magnetic signatures. The magnetic gradient contours illustrate an area where the normally parallel contours appear chaotic. This pattern may be the result of the earlier excavations undertaken around the stakes, or a buildup of broken down organic waste (dead shellfish and plants) deposited around the stakes prior to their complete burial. All the other magnetic perturbations recorded



FIG 10
1nT contour line of the west field of DMN (J.B. Pelletier).

in the pond and canals were associated with modern ferrous material found around the margins of the ponds. The magnetic response recorded in the DMN fish pond should be compared to the response of other inundated stake yards to determine if the chaotic pattern is comparable, and can be used as a marker for future data analysis.

Side Scan Survey

A TriTech 450 kHz FM scanning chirp side scan sonar system was used to collect acoustic images of the riverbed. A TriTech P60 GPS provided the side scan navigation. Positional accuracy of 1–2 m was achieved by surveying during clear weather and minimizing the amount of multi-pathing from overhead obstructions. Navigation fixes were imbedded with the acoustic data in real time, allowing sonar images to be geo-referenced and individual side scan anomalies to be enumerated and measured. The system was installed in a local bamboo boat, which was operated by a tender with oars (Fig. 11). For the survey on the

Bạch Đằng River, a larger motorized wooden boat was hired. Acoustic data were reviewed for anomalies during collection, and reviewed again during post-processing using Hypack® data review module and ESRI ArcView 9.3 GIS software. These computer programs were used to assess the duration, amplitude, and complexity of individual acoustic anomalies. The software was also used to plot anomaly positions within the project area in order to better understand their spatial distribution and associations.

The side scan sonar survey of the Old Kanh River recorded an acoustic anomaly that is clearly illustrative of a locally made small sunken bamboo boat (Fig. 12). Later in the same location, a magnetic anomaly (M29) was detected. A survey along the Bạch Đằng River also recorded a buried tree trunk and two geomorphic features. The geomorphic features included a scoured channel and a gravelly area, which appear as a series of small highly reflective points distributed over a 6.5 x 10.0 m area. The only acoustic method used was a FM chirp side scan

FIG 11
The side scan sonar survey conducted using a traditional bamboo boat (J.B. Pelletier).

FIG 12
A side scan image of a sunken bamboo boat (J.B. Pelletier).



Table 3 An Example of Soil Coring Data from Core #60

Coring at DMN Westerly direction - 60 Line (40 m, 40 m, 40 m & 30 m apart)
0–50 cm: Sand, Colour blackish grey (Hue 10 YR 3/1), tiny specks of Mica (shiny rock/sediment), no organic inclusions.
50–96 cm: Sand, Colour blackish-grey (Hue 10 YR 3/1), tiny specks of Mica (shiny rock/sediment), no organic inclusions. Very waterlogged.
96–135 cm: Sand, Colour blackish grey (Hue 10 YR 3/1), tiny specks of Mica (shiny rock/sediment), Shell Hash at 120–130 cm, few organic inclusions. Very waterlogged.
135–164 cm: Sand, Colour blackish grey (Hue 10 YR 3/1), tiny specks of Mica (shiny rock/sediment), Shell Hash at 120–130 cm, few organic inclusions. Very waterlogged.
164–216 cm: Sand, Colour blackish-grey (Hue 10 YR 3/1), tiny specks of Mica (shiny rock/sediment), lots more slightly bigger Shell Hash than previous core, few organic inclusions. Very waterlogged.
216–253 cm: Sand, Colour blackish-grey (Hue 10 YR 3/1), tiny specks of Mica (shiny rock/sediment), less Shell Hash than previous core, few organic inclusions. Very waterlogged.
253–288 cm: Sand, Colour blackish grey (Hue 10 YR 3/1), tiny specks of Mica (shiny rock/sediment), lots more slightly bigger Shell Hash than previous core, few organic inclusions. Very waterlogged.
288–305 cm: Very fine/powdery brown grey clay. Lense of coarse light grey sand, no organics, less mica.
305–354 cm: Fine, sticky, blackish grey sandy silt. Less Shell Hash, few plant organic inclusions, small lense of grey coarse sand.
354–388 cm: Fine, sticky, blackish grey sandy silt. Less Shell Hash, few plant organic inclusions, small lense of grey coarse sand.

sonar, but this system worked very well to record small sunken vernacular watercraft, and lithology changes in the drainage canals and riverine environs. As this was a trial run for this method, only a small portion of the area was surveyed. Nonetheless, the side scan sonar proved to be useful even in a narrow channel and running transects from a small watercraft.

Sediment Coring & Test Excavations

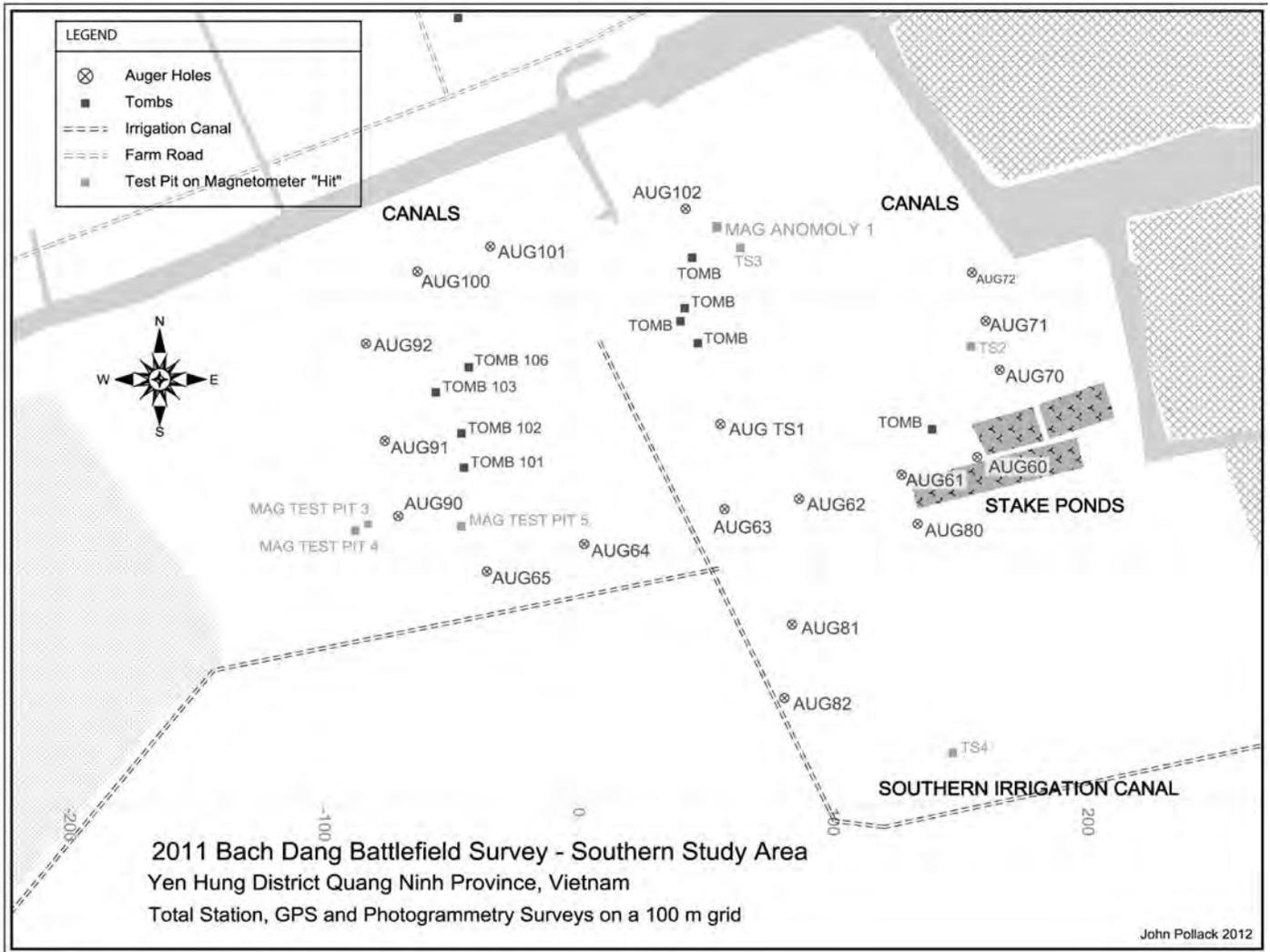
Hand-coring is useful for understanding the channels of ancient rivers currently under reclaimed lands which serve as rice paddy fields. Two sets of augers, which extend to 5 m in length, were prepared by the Institute of Archaeology and the Institute of Geology in Hanoi (Table 3 and Fig.13). A total of 61 auger holes were

opened. The corings were aligned either from north to south or from east to west, set at intervals of 20 or 30 m, depending on modern land-use and boundaries. The results presented here are the preliminary analysis by staff from the Institute of Geology who are currently conducting detailed analysis of the soil samples collected during the survey.

The rice paddy field in front of Duong Giang is regarded as the floodplain of the ancient Kanh river. The line of auger holes extended west, crossing over the narrow irrigation channel running from north to south. The soil profile in this area was complex. Most of the profile showed patterns of alternating sand and silt layers with some clay mixed in. It appears that the entire area was a low level estuary or inter-tidal



FIG 13
Soil coring in operation
(R. Sasaki).



Traverse PC

FIG 14
Map of the fields at DMN
with core numbers indicated
(J. Pollack).

zone, but was also dry ground at some time in the past. Small streams may have run in some parts of the fields. The water table was also high, which made the collection of samples difficult and often prevented accurate measurements for creating a profile. A layer of hard shells was detected in several auger holes at a depth of around 220–240 cm. Perhaps this can be interpreted as a river-bed layer. Layers with shells were encountered more frequently towards the west and closer to the Bạch Đằng River.

The soil profile at DMN was considerably different from the profile at Duong Giang. It is presumed that there was once a large stream running through the area, which was also suggested by the presence of stakes. One characteristic of the soil in this area is the presence of large pieces of

oyster shells, perhaps indicating a salt or brackish water environment. The layer with small shell hash was present in many of the profiles, and these shells are possible fresh water species, indicating an intertidal zone of the river. The elevation at which these two layers occur may point to the presence of changing shorelines. For example, cores 60–66, running east to west, exhibit an interesting profile (Fig. 14). Starting from the easternmost core 60, small shells were present between 120 and 290 cm deep. No oyster shell was detected from this core. Cores 61, 62, and 63 showed a somewhat different soil profile, with small shells beginning at 137 cm and continuing to a depth of 250 cm where oyster shells were found, and the soil became rich in clay. Core 64 had a distinct profile, with consistently sandy soil and some

silt at lower depths, but very little clay. Furthermore, the small shell layer first detected around 90 cm continued throughout the profile. Only a few fragments of oyster shells were detected. This might be where a small stream was once located. Core 65 had a hard layer of thick oyster shells and hard rocks were encountered at the depth of 100 cm; Core 66 could not be tested deeper than about 20 cm because of the layer of hard rocks. These profiles indicate that there was once a shoreline sloping down towards the east. Also, there may have been a small stream running north-south, as indicated by the profile of core 64.

The results from soil coring so far indicate a methodological success. The Duong Giang seems to be an area that once had a small stream, but the land has been much altered and continuously farmed. No evidence of a large stream or river was found, and it appears that the area may not have wooden stakes after all. On the other hand, the soil profiles of the DMN area indicate an active stream system. This area had less developed laterite soil, suggesting that it has not been used extensively by local residents. The large rocks towards the south and southwest are believed to extend towards the Bạch Đằng River and are thought to represent the southernmost extent of the stake yards.

Interviews

The physical record of the landscape was supplemented by eye-witness accounts and cultural histories of people in two of the local villages. A total of 16 interviews were conducted during the fieldwork. In 2011 the themes discussed by the participants included the location of stakes, and the cultural traditions and worship surrounding the battle. One participant, whose family has been in the area for 10 generations, noted that his great grandparents had told him that many stakes were in the area, located near the commune

houses. Another participant noted that stakes found in the 1980s were used in the construction of a shrine. There are many similar reports but for the most part, the interviewees did not remember the exact locations of the stakes. Some did recall seeing stakes more recently, but the majority of those stakes were observed and mapped by an INA research team in previous seasons. It is difficult to separate myth from what actually happened 700 years ago. Perhaps, more interviews should be conducted in the future and in different areas to gather more information about the location of possible stakeyards.

Conclusion

The 2011 season employed various survey techniques and was one of the most intensive survey seasons ever conducted at Bạch Đằng. The two areas, Duong Giang and Dong Ma Ngua, although located close to each other, produced different survey results. The project team was divided into groups who performed a variety of different tasks, including cartographic survey, remote-sensing surveys both on land and over water, and sediment/soil studies. The cartographic survey was successful in producing accurate maps and the benchmarks established (with global positioning) can be used for future projects. The metal detector and GPR surveys showed limited success because of the presence of iron-rich soil. The results of the gradiometer survey suggest this methodology should be used for any upcoming work at the site. Sources of strong magnetic anomalies, including graves and modern debris, also have been identified and the magnetic features recorded. The side scan sonar survey may be conducted next season. The soil coring survey also provided useful information about the past landscape and land use in more recent times, which is one of the most important pieces of information for determining where

the stakes and remains of ships may be buried. The interviews conducted did not yield any breakthrough discoveries, however, considering that the townsfolk are always opening new lands for development and they know the area well, this methodology should be continued. Locals do not necessarily understand the significance of what they may discover when they run across something that is “out of the ordinary.” They can know that “something” is there, but it takes the eyes and experience of a trained archaeologist to reveal the significance of what has been found. The next task is to integrate all of our different survey results. For example, the gradiometer data and the coring profile information should be seen as different “layers” of information in determining the past landscape and possible future excavation area.

Preliminary conclusions suggest that Duong Giang was an area where the landscape has been altered by human activities for centuries. There was little indication of a large stream in which wooden stakes may have been placed. The gradiometer data also showed only a small number of possible cultural remains; however, the ancient landscape may have been more complex towards the western edge of the research area. The area west of Duong Giang may be an excellent location for survey in future seasons. DMN area also holds potential for further survey. The gradiometric data suggest several anomalies not from modern debris but most likely from cultural remains of the past. This area is dotted with burials, and the potential for finding remains from 700 years ago seems to be high. The soil coring study also suggests that an ancient river once ran through this area and a smaller stream may have also been present. If these existed in the area at the time of the invasion, the field around DMN would have been an ideal site to trap the Mongol fleet. The importance of the project

is not limited to the possibility of discovering shipwrecks rich in history and archaeology. The battle strategy that Genral Trần Hưng Đạo used 700 years ago changed the nation's course; continued research at the site will soon reveal the detailed story of this legendary naval battle.

Acknowledgments

We would like to extend special thanks to Mr. and Mrs. Claude Duthuit for their contribution to the project, as well as other INA Board members who showed interest in this project. In addition, Dr. Lê Thị Liên from the Institute of Archaeology and Dr. Mark Staniforth (Adjunct Senior Research Fellow, Monash University) made this project possible. Our appreciation also go to the people of Vietnam, the local residents, provincial authorities, as well as the staff at the Institute of Archaeology and the Institute of Geology. Among the team members, we would like to applaud Jean Pelletier (URS Corporation) and David Ross (Flinders University) for their contributions both in the field and in writing reports that will be available online. Those who participated in the fieldwork are: Dr. Paddy O'Toole (Monash University), Britt J. Burton (Flinders University), John Pollack (INA), Veronica M. Morris (INA/NAP), and Douglas Inglis (INA/NAP). We appreciate all members for the great work they did to help make this a successful season (Plate 19–p. 72).

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Notes

- ¹ Sasaki and Kimura 2010; Kimura 2011; Le et al 2011.
- ² Sasaki 2008.
- ³ Green et al 1998; Kimura 2010; National Museum of Korea 2006.
- ⁴ Breiner 1999, Fig. 46.



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During the first two seasons of the Bạch Đằng Project, Charlotte was based in Hanoi Vietnam, studying local boatbuilding traditions. An ethnographical investigation on boatbuilding craftsmanship, entrenched in Vietnam's history and culture, is at the heart of her Ph.D. thesis. She hopes to draw the attention of Vietnamese academics to the potential that maritime archaeology has to help to preserve maritime aspects of Vietnamese culture and underwater heritage. She also hopes INA's Bạch Đằng Project, along with her ethnographic studies, will help promote new methodologies and approaches in the academic development of maritime archaeology in Vietnam.

Woven Basket Boats of Vietnam

Introduction

On the day the Mongols arrived to face them across the Red River, at Bạch Hạc junction, the Trần positioned a number of boats further downstream: "Men, horses and elephants spread out along the bank. Boats were set up along the lower part of the river for a quick get away." (Đại Việt sử ký toàn thư, note 48, p. 259)¹

Three seasons of the Bạch Đằng Project progressively lead us closer to understanding both the battle itself and the strategies of Trần Hưng Đạo, yet, we still have very little information on the naval forces used in Đại Việt in the 13th century.²

The Bạch Đằng Project provided a unique opportunity to dive further into the maritime cultural landscape of the region, a pivotal pursuit for me as a maritime archaeologist working specifically on boatbuilding in pre-colonial Vietnam. Interested in exploring the type of boats the Đại Việt navy could have used during the oppositions between the Mongols and Đại Việt, I took the chance to examine near the ancient Bạch Đằng battle field, a unique woven basket boatbuilding tradition that is specific to Vietnam.³ Unfortunately, data on boat building in Vietnam prior to the 19th century are scarce.⁴ As such the aim of my study was not to directly identify the boats of Đại Việt, but rather to produce data that could be relevant for investigating the potential of the Đại Việt fleet: the materials available for boat building, the sizes, the propulsion systems and the available nautical technology.

As an outgrowth of the Bạch Đằng Project presented in this volume (Sasaki & Kimura), the following paper intends to showcase the originality and *savoir faire* of Vietnamese boat builders by outlining the general construction sequence and characteristics of contemporary basket boats (Fig. 1).



FIG 1
Thuyền nan in Thác Bà Lake.
2009 (P. Moreau).



FIG 2
Ghe thúng chài. 2006
 (C. Palmer).

Background

Basket boats are common craft in Vietnam (Plates 20 & 21—p. 72). They are widely dispersed along the Vietnamese coastline and differ in size, shape, and use, which range from sea-going, riverine to small floating shops on rice fields and as tenders to larger boats. They are regularly spotted in the famous Hạ Long Bay (northern Vietnam), alongside the “dragon sails” replicas of Chinese-style junks used for the tourists. However, the greatest diversity of basket boat types appears in central Vietnam, from the provinces of Quảng Trị to Phan Thiết.

The fragile nature of bamboo craft unfortunately results in an absence of early archaeological examples of basket boats, but legend suggests that they were developed during the 10th century.⁵ The Đại Việt gained its independence and reaffirmed its Vietnamese cultural identity by ending a millennium of Chinese domination in the first major naval battle on the Bạch Đằng River with the defeat of the Han in 938 C.E. Legend tells us that around 968 C.E., in order to cross the rivers and the swamps and fight the tenacious Chinese troops, General Trần Ung Long introduced a multi-purpose woven-bamboo tool, which combined a water-crossing device with a shield that could easily be carried by a single armed soldier. In spite of the legend, however, considering the materials, tools and techniques used in basket boat construction, it is possible that the vessel type was developed at an earlier date. We have, however, no data from the pre-colonial period, apart from a few mentions that could refer to basket boats written in the reports of French Missionaries. In 1746, Edmond Bennetat complained of “nasty little skiffs”⁶ used to cross from an offshore island to the coast in the region of Nha Ru in central Vietnam. And Paul-Jean-Baptiste Bourguin related that the skiffs used in that region were “so small that I wouldn’t dare to embark even when the weather or the sea are very calm.”⁷ Around 1835, a Chinese traveler, Tsai-Tin-Lang also described a bamboo boat from Annam (central Vietnam) that he called *ia-tszy*, “the bottom floor of these boats is made of bamboo beams and is varnished with coconut oil; the deck only is made out of (hardwood) planks; smaller boats are built with similar materials.”⁸

References to and descriptions of Vietnamese crafts become more extensive in late-19th and early-20th century literature. For example, there were some rather large sea-going fishing vessels reaching about 20 meters¹⁰ and with a tonnage of about 50 tonnes (that sometimes exceeded 120 tonnes),¹¹ constructed with woven bamboo hulls and extended by wooden top strakes that were discussed in more eloquent terms. Commander Audemard (1865–1955), described a three-masted *gai nane* of 16.5 m long, 3.7 m wide and of a tonnage of 50 tonnes,¹² while Jean-Baptiste Pietri in 1942 stated that, “all the countries have their types of boats, elegant in shape or great in their way of sailing [or appearance], but probably nowhere in the world is there a hull as original and as recklessly built, it seems, as the *ghe bầu* of Quảng- Ngãi, in its nang variety, meaning with woven bottoms”.¹³ For him, the *ghe nang* was “one of the most unusual types of ships in the world.”¹⁴ Unfortunately, these large ships have now disappeared¹⁵ and the smaller versions of these “mixed hulls” (12 m / 10 tonnes) are becoming rarer yet in 2010 when I recorded a few in the province of Quy Nhon.

Basket boats are referred to by different names and caution needs to be taken because the names tend to be generic and do not refer to any particular type. Rather, the boats are described according to their size, use, location or physical characteristics. For example, in the village of Hưng Học, near the Đồng Má Ngựa excavation site, the small elongated basket boats were referred to as *truong bảy* (meaning 7 times a 40 cm length, approximately 2.8 m long) while the larger ones are called *truong hai mươi* (meaning 20 times a 40 cm length, about 8 m long) (Figs. 2 & 3).

Vietnamese name	Description	Translations
<i>thuyền nan</i>	common basket boat	<i>thuyền</i> = boat in the north
<i>thuyền mung</i>	small boat-shaped basket, used as a tender to larger vessels	<i>mung</i> (<i>thúng mung</i>) = basket
<i>ghe thúng chài</i> <i>thuyền thúng</i>	small common round boat resembling coracles	<i>ghe</i> = boat in the south <i>thúng</i> = basket <i>chài</i> = to fish with a casting net <i>thuyền chài</i> = fishing boat <i>ghe chài</i> = fishing junk
<i>thuyền tre</i>	long basket boat	<i>cây tre</i> = bamboo
<i>sông vánh</i>	This boat is also called <i>song An-Giu</i> after the name of a village in Binh Dinh, specializing in shark fishing. ¹⁶	
<i>ghe xuồng</i>	small canoe that has ribs outside its hull	<i>xuồng</i> = whale boat <i>bơi xuồng</i> = to canoe
<i>ghe nang</i>	mixed hull (bamboo hull and wooden strakes)	

From the small round *thuyền thúng chài* to the longer oval *thuyền nan*, bamboo boats are the cheapest option due to locally available material and a rapid construction sequence. All types can be fitted with a mast and helm. The great advantage of bamboo is that it is not particularly favored by xylophages and teredos (*Teredo* sp. & *Bankia* sp.) due to its high silica content and to the fact that the bamboo laths are also usually too thin to be good hosts.¹⁷

Construction

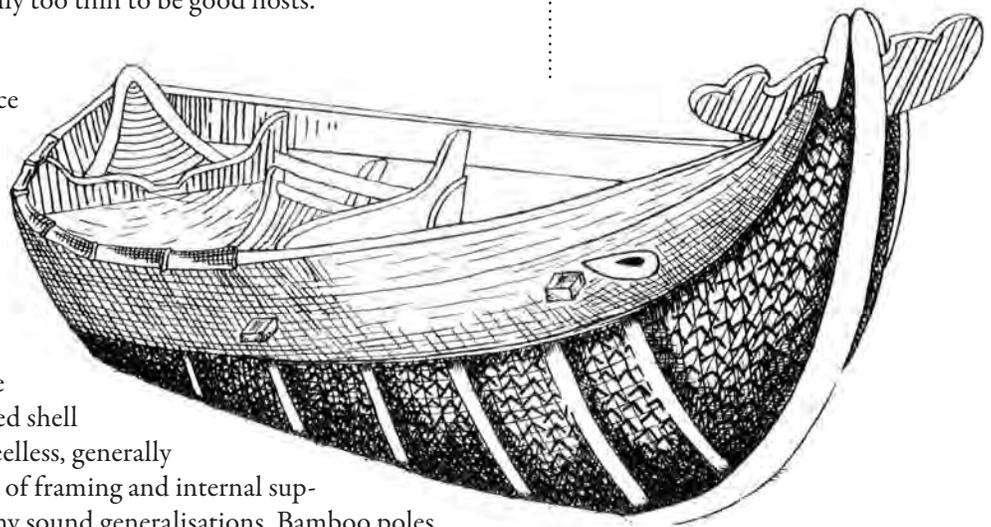
The following construction sequence is based on previously published documents¹⁸ and on comparative data from Bạch Đằng (2009 and 2010), Thác Bà Lake in Yên Bái Province (2009) and from the Scottish Eyemouth Maritime Centre (2008).

Like most Vietnamese boats, the bamboo basket boats are constructed shell first with a flexible hull. They are keelless, generally with easy round bilges; the amount of framing and internal support varies too much to allow for any sound generalisations. Bamboo poles, whole or split, generally serve as structural members, alone or with other woods in plank or timber form.¹⁹ They are conceptualized as a watertight shell but their structural strength lies in the reinforcing wale, the internal frames and the side-strings—not in the hull itself.

To build a basket boat four to five meters in length, it takes about eight days with a three-man workforce (including five days to dry out the hull before coating);²⁰ one man can build a small one (2.6 m) in one week.

In 1997, the *thuyền nan* described by Tallec²¹ cost about 550 000 VND (\$26 USD), while today the comparable *truong 14* of the same size costs about

FIG 3
Ghe xuồng (Pietri 1943: fig. 69).





ABOVE

FIG 4

Setting the laths on the floor to start the weaving. 2010 (C. Pham).

RIGHT

FIG 5

Different types of bamboo weaves (Cairo 1972: 137 fig. 3c, 146 fig 6c).

FIG 6a & b

Weaving technique “4-1-1.” 2010 (M. Girard).

FACING FROM TOP

FIG 7

Shaping the bamboo mat. 2007 (C. Palmer).

FIG 8

The bamboo mat is laid in a cement pit, covered with stones to maintain its shape. 2010 (C. Pham).

FIG 9

Setting the gunwale. 2010 (C. Pham).

FIG 10

Cement is used to caulk a basket boat in Yên Bái. 2009 (P. Moreau).

FIG 11 a & b

In Hưng Học, the boats are first covered with buffalo dung and then with two layers of tar. 2010 (M. Bui). The tar is boiled and applied with a frayed banana branch. 2010 (C. Pham).

3 000 000 VND (\$144 USD). If well-maintained, bamboo hulls can last about five years and are easily replaced. “These bamboo boats are surprisingly resilient, and are well adapted to absorb the shocks of surf and strains of beaching. Plus, bamboo is plentiful and cheap—important to the fisherfolk and river dwellers.”²²

1. Preparing the bamboo laths

Bamboo poles are cut into long, thin laths (0.03 cm thick and 2.50 cm wide). Between 50 and 100 green bamboo poles (each 5.5 m long) are necessary to create a boat 4–5 m long. About 80 laths are necessary for a bamboo boat 3.0 m long and 1.5 m wide) (Fig. 4).

2. Weaving the bamboo mat

In Vietnam, I observed different weaving patterns but no typology has yet been created to determine whether pattern depends on the boat builder, the region, or other cultural or technological factors (Fig. 5).

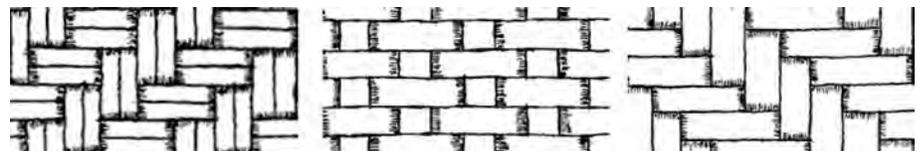
The process/sequence I observed in northern Vietnam and in Bạch Đằng can be described as follows:

First, to weave a mat all the long laths are laid down as the warp and four transverse shorter laths are laid out across the center as the weft (Fig. 4). Then the weaving begins. The long laths are passed over four shorter ones, then under the following three, then over the next four and so on. This technique is called “4-1-1,” meaning four laths will be over, then one under, then one over, then again four above, one under, one over, etc.

The laths are sometimes wetted to provide flexibility and the weaving often lasts one full afternoon (Figs. 6a & b).

3. Shaping the hull and setting the wales

Once the mat is woven, it is laid down in a pit or set within stakes dug into the ground. The mat is then shaped by being covered with large stones or sand for greater uniformity. The design of the boat depends on the shape of the pit; all boats constructed by one boat builder will have the same size and shape. Elongated basket boats have either pointed or rounded ends (Figs. 7 & 8).



In order to give strength and structure to the hull, a wale composed of two half-bamboo poles is lashed around the woven mat with bamboo lashing or heated copper wire. Once this belt is securely fastened, the hull is taken out of the pit and is caulked inside out (Fig. 9).

The construction sequence of round basket boats²³ is slightly different as the hull shape is not achieved by laying the mat in a pit but rather by being fixed to a round bamboo frame and then filled with sand. First, the bamboo “gunwale” is shaped by being fixed between small pickets stuck in the ground. Then, other bamboo laths are clamped to that round framework to strengthen it. Finally, the mat is fitted inside the structure. The mat is lashed to the gunwale with bamboo straps and then, internal stringers are inserted inside the hull to reinforce the structure. As with long basket boats, once the hull is reinforced with the stringers, it is completely coated inside and out.

4. Waterproofing

Nowadays cement or tar and cattle dung are widely used to protect the bamboo shell, but other recipes still exist and vary according to the region and descriptions also vary according to originating periods. “Indochinese lacquer”²⁴ is exclusively used in the north by different sorts of wood workers. It is produced by the *cây son* myrtle tree (*Rhus succedanea*) and is mixed with sawdust that creates a black coating. The preferred recipe in central Vietnam is *chai*, which is composed of powdered *Shorea* resin and *Dipterocarpus* oleo-resin. This resin is known to be used since the early Cham times in central Vietnam to bind bricks of the architectural complex of My Son. In order to ensure long-term preservation of the hull, this outer coating needs to be re-applied several times a year. Nowadays it is often replaced by cement or tar (Fig. 10; Fig. 11 a & b).

5. “Floor timbers”, “cross beams” and “thwarts”

Once the coating is dry, additional wood or bamboo beams are laid across the hull and thwarts or benches are fitted and fastened with bamboo treenails to reinforce the structure. (Fig. 12)

In the village of Hưng Hộc where the Đông Má Ngựa excavation project took place, these thwarts are called *thang*; they can be considered benches, and a deck may also be fitted over them. Into one thwart, an additional square opening is also drilled on each side, in order to fit the oarlocks. In less than 10 minutes, four thwarts can be installed. “Often there are several bamboo bilge and bottom stringers, and heavy frames for additional support. This is especially true for the larger all-basket sailing boats. Frequently deck battens or dunnage are installed in the bottom of the boats to give better footing”²⁶ (Fig. 13).

6. Side-stringers

Additional external reinforcement is necessary to avoid deformation and distortion. Hence, side-stringers or an external framing can be lashed along the wale. It can be done so with heated copper wires. The side stringers are constructed from bamboo for the small boats (2.6 m). On larger boats, they are made out of wood and look like a large rectangular frame that rests over the thwarts. This is the final phase of construction. Once the boat is sold, the owner customises the hull according to the necessities, such as fitting a deck, a woven bamboo roof or fish traps.

Boat Operation

Since the 1960s, motorised long-tails and engines have been the most common propulsion systems. Even the junks in Hạ Long Bay with their traditional dragon sails are motorised. However, traditionally, basket boats were propelled by hand (rowing) or wind power. Basket sailboats are quite



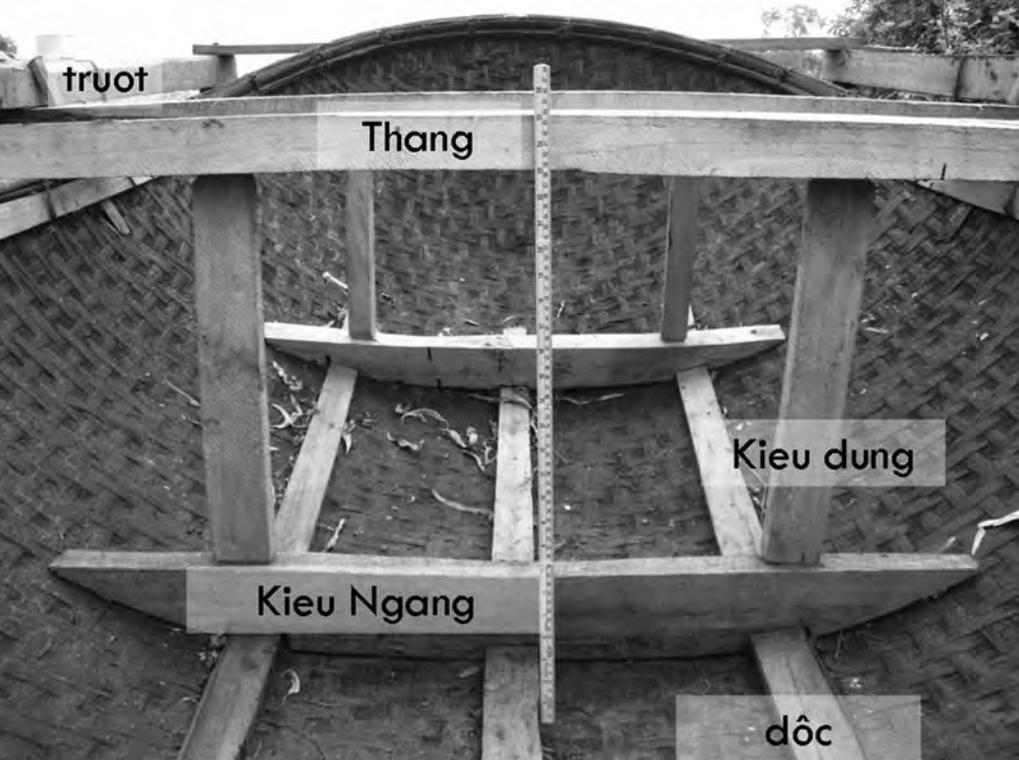


FIG 12
Internal structure of a
"truong 14." 2010 (C. Pham).

rare today but small crafts are still rowed.

1. Propulsion

As is the case elsewhere in Southeast Asia,²⁷ oars with handles (*avirons à béquille*) are the most commonly used in Vietnam. They can be carved from one piece of wood although the handle and the blade are usually made of two different pieces joined with a lashing along a bevel.²⁸

To row an elongated basket boat, the rower usually faces the direction of the route and pushes the oar down in the water towards the front, either standing up or sitting down. The movement makes elongated ovals, ending with the arms and body straightened towards the sky. The oarlocks do not provide a solid or rigid casing through which the oar passes, rather, the oars feel like they are hanging and hence provides the rower with a feeling of looseness. The oars are pulled against the lashing instead of being pushed against the rigid oarlocks.²⁹

Another common way of handling the oars on small fishing vessels is "foot-rowing", which is particularly seen in northern Vietnam. The soles of the feet are fitted to the handle and the rower rests his/her back on

two bamboo poles set in a thwart at the stern of the bamboo hull. As such, the Vietnamese pedal with their feet, hands free or holding a fishing net (Fig. 14).

As the two ends of these basket boats are identical, the distinction between bow and stern becomes obvious only once the oarlocks are fitted. Then, the end closer to the oarlocks is the stern (*đuôi thuyền - đi sau*) and the other is the bow (*mũi thuyền - đi trước*).

2. Rudders

Because the basket boats never have a keel, the rudders are essential when they are under sail. To maintain a straight bearing and prevent them from falling to leeward, shipbuilders developed steering devices that supplemented the basic steering oar. Their peculiarity is that, as in China, Vietnamese rudders and guares³⁰ or centerboards are all retractable, enabling vessels to navigate easily in shallow waters and to land. There are a variety of helm types³¹ in Vietnamese watercraft but two essential types can be distinguished: the basic helm with braces hanging on the round bamboo gunwale fixed with pintles and gudgeons and the axial helm sliding in a fitted wood block at the stern with wedges to hold it in an retracted position (Fig. 15).

3. Unique features of the "mixed hulls"

"Mixed hulls" (bamboo hull and wooden strakes) are mostly seen in central Vietnam and are worth mentioning for their very specific features. They have a rudder sliding in the stern post and a sliding "bow board" fitted in the stem or "stem daggerboard" the term used by Cairo,³² which takes the place of the centerboard that cannot exist in a bamboo hull. By controlling its sliding, the boat is able to manoeuvre more or less close to the wind. The stem is grooved and the bow board is fixed on the longitudinal axis. It cannot rotate and the shape of the blade is a bent dagger or *yataghan*³³ that curves under the hull. Its posi-

tion can change; fully down when close hauled, partly down on a reach, and up when running free. This “bow board” serves as an anti-leeway device, contributes indirectly to the steering, and enables the crew to adapt to the irregularity of the coast and to bring the vessel ashore easily (Fig. 16).

The mixed hulls are without keels, however the larger the hull, the more substantial their structure becomes with possible combination of frames, floors, thwarts, bamboo keelson and stringers, athwart beams and knees.³⁴ Wooden pegs are employed to attach the strakes to the stem and sternposts. The ends of the athwart beams project through holes in the strakes, and are sometimes pegged into position.

Conclusion

Reliable information concerning traditional boat technology and early seafaring in Vietnam is still scarce and the limited available data do not provide substantial evidence to suggest the type of boats Đại Việt forces may have used to stand against the Mongols. However, by deepening our knowledge of regional boat-building traditions it is possible to start building a more precise image of what those traditional vessels may have looked like and ultimately to understand the practicalities of the maritime events that occurred at the Bạch Đằng battle site.

The aim of this study was to gather data on existing basket boats to demonstrate the potential of maritime ethnographic inquiry. Various aspects of the construction sequence can still be further examined; waterproofing recipes could be set against a chronology and/or cultural trends; a typology of basket weaving patterns could be assembled, and linguistic, geographic or social links could be established between them. When materials, recipes, tools and other elements of construction and rigging are better understood, the construction sequence might be tied

into cultural spheres, be related to specific economic or political contexts and be evaluated against historical events. In this way, technological changes can be addressed in a historical framework and events like migration and cultural exchanges can help to investigate the origin, evolution, distribution and the role of early seafaring.

Finally, I believe that through maritime ethnography and the study of contemporary boat traditions, it is possible to achieve a better understanding of the cultural tradition that determines a ship construction technique in a region, and that it can also help to interpret boat building and boat use in the past. It can build knowledge useful for the maritime historian as well as for the maritime archaeologist and can be valuable for interpreting future archaeological boat finds.

As traditional boats are disappearing due to the introduction of foreign materials and techniques, this report also aims to preserve for the long-term information about this unique type of watercraft. Ultimately, I hope that this study provides a glimpse into Vietnam’s varied boat culture and that it revealed the potential of more specific studies of Vietnamese watercraft.

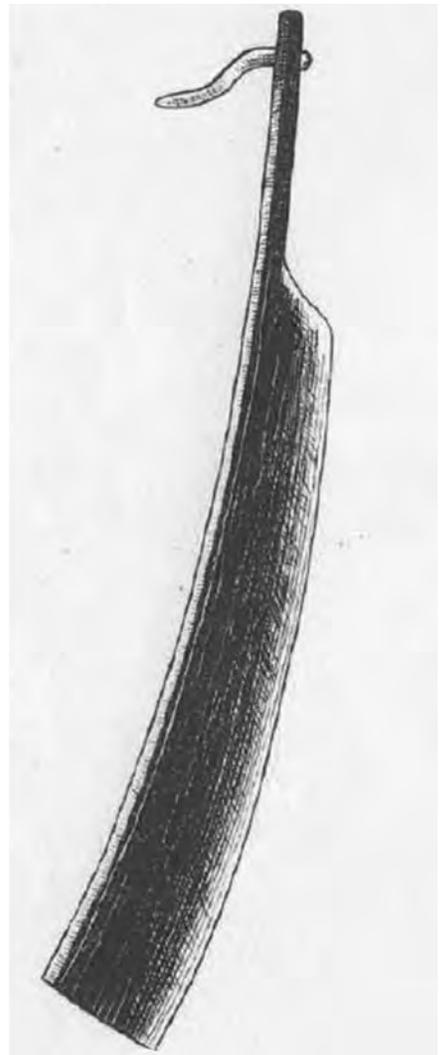
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FIG 13
The thwarts are laid out across a “truong 7” and the pegs are hammered in the gunwale. 2010 (M. Girard).

FIG 14
Foot rowing in Hạ Long Bay. 2006 (C. Palmer).



in Vietnam.

Unless otherwise stated, all pictures were taken at Mr. Toàn Huyện's boatyard, Hưng Học Village, Quảng Ninh Province, whose family is acknowledged here for their help and incredible kindness.

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FIG 15
Different types of rudders fitted onto basket boats. 2006 (C. Palmer).

FIG 16
Sliding bow board on a "mixed hull." 2006 (C. Palmer) (Pietri 943: fig. 46).

their impact on relations between Đại Việt and Champa (1226–1336 C.E.). Ph.D. Thesis, School of Oriental and African Studies, Department of History, University of London.

Notes

¹ In Vu-Warder 2008, 89.

² Pham 2012.

³ Woven basket boats are not always round and of small sizes but can reach 10–15 m in length, which differentiates this tradition from that of the Irakian Quffas tradition. The method of construction and the materials also make this tradition quite different from the Indian coracles, currachs, from the bull boats of the Sioux made of bison skin and willow framework or from the reed boats from South America.

⁴ Pham, Blue, and Palmer 2010.

⁵ Huard and Durand 1954, 226.

⁶ M. Bennetat aux Directeurs du Séminaire des Missions Etrangères, 20 juin 1746, Archives Missions Etrangères de Paris, vol. 741, p. 657 (in French, translated by author: “les chrétiens qui étaient de l’autre côté de la rivière m’envoyèrent une méchante petite nacelle”). The word *nacelle* or *nacele* in old French, comes from the Latin *navicella*. It is a small boat with no mast or sails and can be interpreted here either as a basket (as in a hot air balloon) or as a skiff.

⁷ Journal de M. Bourguine, le 24 aout 1745, Archives Missions Etrangères de Paris, vol. 800, p. 663 (in French, translated by author: “Remarquez qu’ils viennent sur des nacelles si petites, que je n’oserais pas m’y embarquer dans le temps où la mer est la plus tranquille”).

⁸ Tsai-Tin-Lang 1878, 157 (in French, translated by author: “C’était un bâtiment annamite, un ia-tszy. Le fond de ces bateaux est fait en madriers de bambou et verni d’huile de coco; le pont seul est en planches; de petites barques sont construites des mêmes matériaux.”).

⁹ Paris 1942; Pietri 1943; Pâris 1841; Audemard 1970; Poujade 1940; Ky 1875.

¹⁰ Paris 1942, 378.

¹¹ Pietri 1943, 61.

¹² Audemard 1970, 30–31.

¹³ Pietri 1942, 61 (in French, translated by author: “Tous les pays ont leur type de navire, gracieux de forme ou massif d’allure, mais il n’existe probablement nulle part au monde une coque aussi originale et témérairement construite, semble-t-il, que la ghe bâu du Quảng Ngqi, dans sa variété nang, c’est-à-dire à fond tressé.”).

¹⁴ Pietri 1942, 20 (in French, translated by author: “... un des types les plus curieux qui soient au monde: la « ghe nang »”).

¹⁵ Amos 1997.

¹⁶ Pietri 1943, 59.

¹⁷ Aubaile-Sallenave 1987, 81.

¹⁸ Cairo 1972; Burningham 1994;

Amos 1997; Tallec 1997; Bui Thi Mai and Girard 2007.

¹⁹ Cairo 1972, 135.

²⁰ Tallec 1997.

²¹ Tallec 1997, 18.

²² Cairo 1972, 135

²³ For a full construction sequence, see Bui Thi Mai and Girard 2007 or Preston 2009

²⁴ Aubaile Sallenave 1987: 27–34 ; Pietri 1943: 107–109).

²⁵ Binda, Condoleo, and Tedeschi 2009, 171, 286. The Cham polities thrived in central and southern Vietnam between the 7th and 18th centuries.

²⁶ Cairo 1972, 140–141

²⁷ Paris 1942, 379.

²⁸ Tallec 1997, 20.

²⁹ Burningham 1994, 234.

³⁰ Guare: a retractable wooden foil for combating leeway and for steering (a variable lee-board) in McGrail 2001, 468. On page 310, McGrail adds “Guares are used to oppose leeway as well as to steer, and today they are invariably found on sailing rather than paddled or oared craft. Furthermore, whilst they are known to have been used on boats, for example,

Vietnamese basket boats—they are much more frequently found on rafts.”

³¹ Cairo 1972, 147; Burningham 1994, 234.

³² Cairo 1972, 145.

³³ A long knife or short saber, Pietri 1943, 70.

³⁴ Cairo 1972, 142.

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