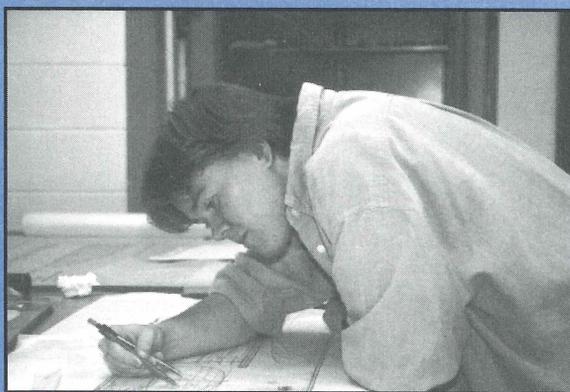
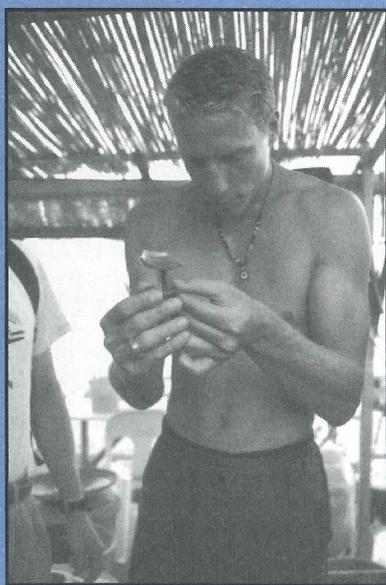


THE INA QUARTERLY

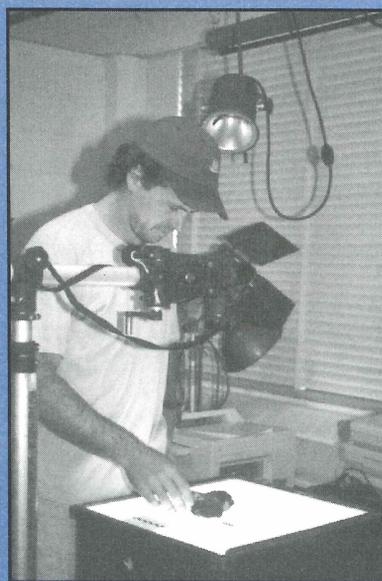


Summer 1997

Volume 24 • No. 2



*Scholars
at
Work*



The INA Quarterly

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On the cover: Scholars at Work. From top left, clockwise. Brian Jordan examines the delicate glass goblet remains he excavated last summer at Bozburun, Turkey. Erika Washburn puts the final touches to her drawings of the vessel *Linnet* that is the subject of her thesis. Eric Emery, whose research on the U.S. Navy row galley *Allen* will be the subject of his dissertation, at work in the photographic laboratory. Harun Özdás, a visiting scholar from Turkey, completed valuable research for his dissertation while studying at the Institute over the last year. Photos by C. A. Powell.

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The Home Page for INA and the Texas A&M University Nautical Archaeology Program on the WorldWideWeb is <http://nautarch.tamu.edu>

The Institute of Nautical Archaeology is a non-profit scientific and educational organization, incorporated in 1972. Since 1976, INA has been affiliated with Texas A&M University, where INA faculty teach in the Nautical Archaeology Program of the Department of Anthropology.

The editorship of the *INA Quarterly* is supported by the Anna C. & Oliver C. Colburn Fund.

Work in Progress

Much of the day-to-day work of the Institute of Nautical Archaeology is done by graduate students in the Nautical Archaeology Program in the Department of Anthropology at Texas A&M University. They provide much of the labor for INA excavations, and their scholarship contributes immeasurably to the interpretation and publication of the data INA gathers. These are not merely "scholars in the making," as the cover of the December 1985 *INA Newsletter* (12.3) would have it, but truly "scholars at work." In the following pages, you will see some of the work in progress.

This is not a one-way street. The graduate students also receive priceless benefits from their close association with the Institute. In addition to the opportunity to work on INA's projects around the world, the students have access to the incomparable INA faculty and research facilities. The generation of trained archaeologists that the Program has graduated since 1978 are themselves one of the greatest contributions that INA and its supporters have given to the discipline.

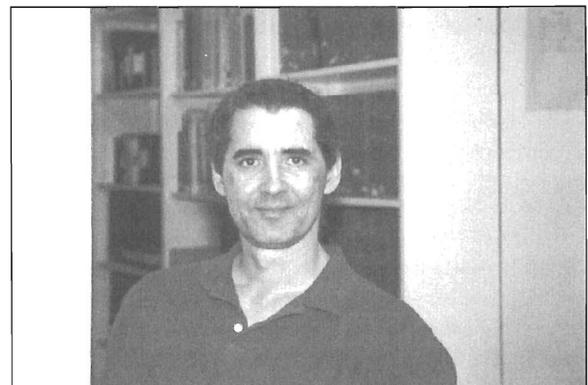
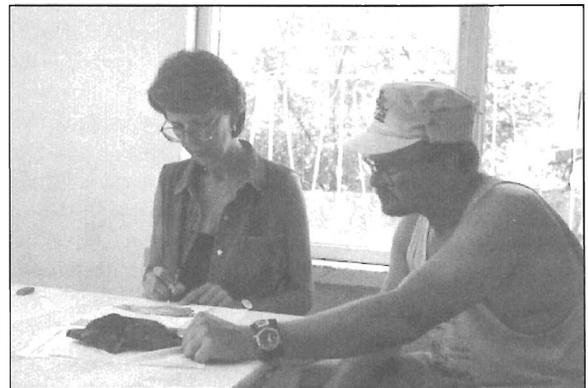
As of May, 1997, seventy-five students had received M.A. degrees through the Nautical Archaeology Program, and eight had received doctorates. In addition to the graduates listed in this issue, at least four (Randal Davis, Samuel Margolin, Richard Swete, and Sheli Smith) completed the program in the early years when a non-thesis master's option was offered. Others received their degrees through other programs in Anthropology, Geography, or another department.

Today, the Nautical Archaeology Program has fifty-five students at various stages of the Master of Arts program, as well as eight doctoral candidates (John Bratten, Bill Charlton, Joseph Cozzi, Eric Emery, Maria Jacobsen, Sam Mark, Christine Powell, and Jeff Royal). It is expected that some exciting work from these students will appear over the next few years, covering a wide range of topics. Many scholars are researching various aspects of INA excavation projects, but their work is not restricted solely to these. Students are encouraged to seek out their own projects. In many cases, they are actively supported by the Institute and Texas A&M University in their endeavors. Unfortunately, the spatial limitations of this issue do not permit a discussion of all of these varied projects, but it is hoped that they will be the subject of an article in a future issue.

A thesis or dissertation often goes on to be part of an excavation's final publication. In other cases it can appear as a journal article, a chapter of a book, or in some cases a book in its own right. Two examples of the latter are reviewed in this issue, but these do not stand alone. Dr. Crisman's thesis on the brig *Eagle* became a book. Dr. Fitzgerald's research became part of the BAR Series published on the excavations at Caesarea Maritima, while part of Dr. Hocker's research was also recently published.

This issue of the *INA Quarterly* is dedicated to the work of A&M graduate students since the Institute moved to College Station in 1976. Eleven articles discuss the A&M doctoral dissertations related to nautical archaeology. A separate categorical compendium provides brief summaries of these, along with seventy-five masters' theses. An alphabetical list of all eighty-six works by author's name follows. Finally, two reviews discuss recent books from the Texas A&M University Press that had their genesis within the Nautical Archaeology Program. In the event that anyone's work has been overlooked or imprecisely summarized, please accept our apologies.

The work of the Program does not always take the form of "archaeology." Often a student has to be a "Jack of all trades" as Jaynie Cox (top) demonstrates, painting the INA camp sign at Bozburun in 1995. Peter Hitchcock (second) has recently been working on the La Salle Shipwreck project and now returns to College Station to complete his thesis. Steve Thornton (third) helps volunteer Judy McNeil draw an artifact during the 1996 season of the Bozburun excavation. Sam Mark (bottom) was formerly the Program's librarian and as of 1 September 1997, will be the Mr. and Mrs. Ray H. Siegfried II Graduate Fellow. His book From Egypt to Mesopotamia will be released in November 1997.



Michael A. Fitzgerald, Ph.D.

Michael Andrew Fitzgerald was awarded the degree of Doctor of Philosophy in 1995. He is now Assistant Editor with the American School of Classical Studies at Athens Publication Division. His dissertation is entitled, "A Roman Wreck at Caesarea Maritima, Israel: A Comparative Study of its Hull and Equipment." Dr. Fitzgerald's research has been published in Volume II of *The Harbours of Caesarea Maritima* in BAR International Series 594 (1994). The dissertation describes his research on a large merchant ship found in the north bay adjacent to the harbor built by Herod the Great in the first century BCE. Although the remains were only partial, Dr. Fitzgerald estimates the original length of the ship at 40–45 meters.

The size makes this wreck site significant. The considerable body of knowledge pertaining to Graeco-Roman shipbuilding and seafaring is grounded primarily in the study of wrecks of ships that did not exceed about 25 m in length. Knowledge of ships of some 30–50 m in length from the ancient Mediterranean is severely limited. To date, only one big seagoing ship, which wrecked off the southern coast of France about 60–40 BCE, has been excavated extensively and published. Investigated during the 1970s near the small town of Giens, it is still under study. Numerous wrecks of other large Roman ships are only partly known. The research by Dr. Fitzgerald was thus aimed at discovering whether there were significant differences between the approach to constructing large ships and the better-known approaches to building smaller ones.

The Caesarea wreck was discovered in the summer of 1976 during a casual survey led by Avner Raban with a group of Israel Underwater Exploration Society divers. The upper extremities of 25 frames were observed protruding from the sand. Their position in less than 2.5 m of water measured some 60 m from the shoreline, inside the partially protected bay about 200 m northwest of the Hellenistic quay at Caesarea. Surveys followed, as well as four seasons of excavation between 1983 and 1988. The site was covered with a thick layer of sand most of the time. Unfortunately, storms have since taken much of the remains, in part because offshore currents have been altered by the construction of a large loading platform a few kilometers south of the site. These losses have occurred despite care taken to protect the site.

Dr. Fitzgerald describes the planking, fastenings, sheathing, lead rings, cordage, and other artifacts associated with the wreck. Chapters are devoted to each of the major categories, with an extensive search of the literature to compare each feature with similar finds from other shipwrecks of the period. The comparative chapters are discrete in order to isolate patterns or trends in the history of Graeco-Roman shipbuilding that can help determine the ship's date of construction. Such patterns or trends may also provide evidence of general practices or principles characteristic of Greek and Roman shipbuilding, as well as illuminating differences between construction approaches to large as opposed to small seagoing vessels of the Graeco-Roman world. The final chapters are devoted to the reconstruction, dating, and analysis of the ship in its historical, archaeological, and technological contexts.

In early Graeco-Roman ships, the planking served as the primary structural component of the hull. This was a result of the way the hulls were built: planks were joined securely to the keel and to one another edge-to-edge with mortise-and-tenon joints. Only after a number of planks had been built up from the keel of the vessel were frames added to serve as secondary sup-

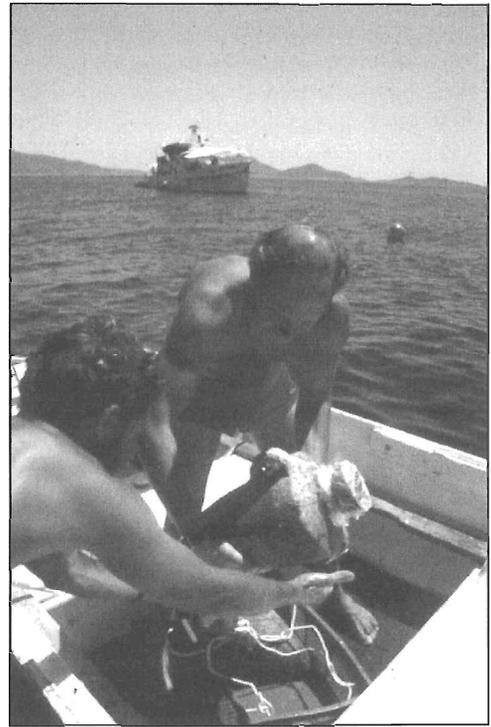


Photo: INA

Dr. Fitzgerald (right), assisted by Michael Halpern, carefully shifts an amphora from its lifting basket onto the dock.

port components. At Caesarea in 1983, a single layer of 16 strakes was found preserved over a width of approximately 3.5 m and a length of more than 14 m. The planks are edge-joined with pegged mortise-and-tenon joints that are staggered across the thickness of each plank. This construction is typical of a Roman vessel from around the turn of the millennium. The planking is of pine, a softwood that provided both lightness and strength. Since the edge-joined hull was more important than the frames in providing structural strength, the ability to cut a great many mortices was essential to ship construction in the period. The planking is thus typical of the period; it is the framing that is unusual.

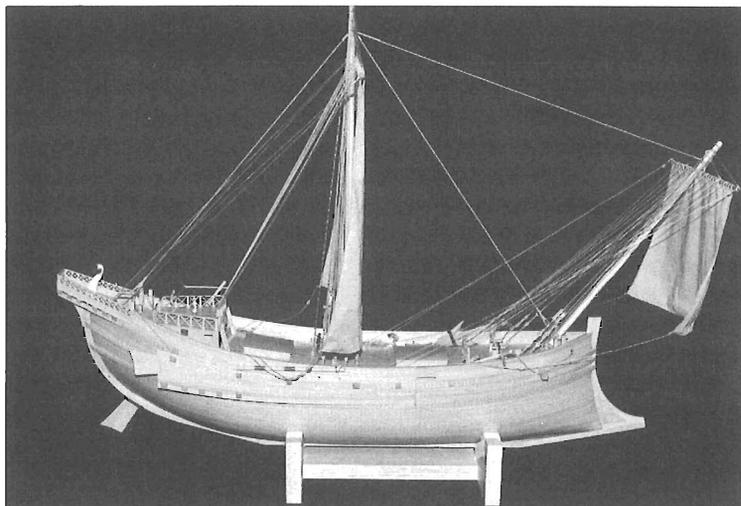
This framing is critical to Dr. Fitzgerald's major conclusions placing the construction of the Caesarea ship in its historical context. The ship had very heavy pine framing, with alternating half-frames and floor-and-futtock sets in typical Greco-Roman fashion. Average spacing of frames (center-to-center) is ca. 0.25 m, as sided dimensions average about 0.18 m. The remains of fasteners gave some evidence of longitudinal stringers. This is truly massive construction for an ancient ship.

Dr. Fitzgerald tentatively concludes that the ship dates from the first century CE. The comparative studies reveal that the ship was probably quite flat-bottomed, measured some 40–45 m in length, and is one of the most heavily built Roman merchant hulls yet documented. In this perhaps unique case, hull construction and equipment details allow the dating of the ship's construction with a fair degree of confidence. The historian Josephus Flavius describes a famine in 46–47 CE that was relieved by grain shipments from Egypt, and this hull seems to match the descriptions in Roman literature of the large vessels that fed the

Empire with Egyptian grain. There are too little data preserved to make a firm identification of this ship as a grain carrier, however.

The most important conclusion drawn in the dissertation may be a new hypothesis regarding Graeco-Roman shipbuilding: that approaches to the construction of large ships differed fundamentally from approaches common to the building of small ships. Due to limitations inherent in the nature of mortise-and-tenon "shell-first" shipbuilding, wherein the shell is the primary structural hull component, frames were more important in large ships than they were in small ships. Shipbuilders thus had centuries of experience in building strong skeletons, even while shell-first techniques remained dominant.

As economic factors changed, shipbuilding methods were adapted accordingly. Labor- and material-intensive methods characteristic of the Greek and Roman periods had to evolve. Mortise-and-tenon joinery techniques proved incompatible with needs for more economical construction methods in the early Byzantine period. The experience gained from the large ships was now applied to smaller vessels. The rudiments of more efficient skeleton-first techniques appeared at least by the fifth or sixth century in smaller ships and by the early ninth century



This model of the Caesarea ship was built to represent the approximately forty-by-nine-meter vessel studied by Dr. Fitzgerald.

on bigger vessels (such as Tantara B). Dr. Fitzgerald's dissertation represents a step forward in understanding how the transition in construction methods came about.

Tommy Ike Hailey, Ph.D.

Tommy Ike Hailey received the degree of Doctor of Philosophy in the Anthropology program in 1994. His dissertation is "The Analysis of 17th-, 18th-, and 19th-Century Ceramics from Port Royal, Jamaica for Lead Release: A Study in Archaeotoxicology." This research attempts to solve a very old mystery, with shades of an episode of *Quincy M.E.*

The concern over lead poisoning in modern times has led scholars to investigate ways in which exposure to lead may have affected past cultures. Many observers of the Jamaican scene in the late 17th and early 18th centuries described a malady known as "The Dry Bellyache," which was among the most common and most fatal local illnesses. The symptoms of this condition correspond rather closely to those of lead poisoning. There has been some speculation as to whether this was, in fact, the source of the illness, and (if so) as to possible sources of the offending metal.

Studies of the possibility of lead poisoning in the past have tended to use historical records and skeletal analyses for evidence, and have ignored artifactual analysis. This dissertation attempts to fill that gap by studying the finds from Port Royal. Although there were many types of artifacts that might contain lead, lead-glazed ceramics were certainly one of the most common. Recent medical records have confirmed cases of lead poisoning caused by the consumption of acidic beverages such as wine, soft drinks, and fruit juice that had been stored or served in glazed earthenware vessels. Therefore, Dr. Hailey focused his research on determining whether the glazes in use at Port Royal might provide a significant source of environmental lead.

Initial tests on ceramic sherds from lead-glazed vessels confirmed the potential for a substantial lead release from these glazes. Further tests on sherds and ceramic tiles with equal glazed surface area allowed the development of a framework for predicting the rate of lead release from any vessel under various conditions. Acidity, temperature, and the volume of solution were the major variables studied. The goal of this approach was a strategy for estimating human lead exposure under different conditions, such as the cooking or storage of various foods and drinks.

Dr. Hailey estimated that a typical individual might have consumed about 450 ml a day of a mildly acidic beverage from a cylindrical pitcher with a radius of 10 cm, filled to a height of 20 cm. Under these conditions, 57.5% of the glazes represented could have posed a significant risk of dangerous blood lead levels within 8 months of daily use. Daily use of lead-glazed cooking vessels could have produced dangerous levels even more quickly.

If these test results can be viewed as representative, there can be little doubt that much of the population of Port Royal must have had chronic lead poisoning to a greater or lesser extent. It is not surprising that many persons eventually developed the acute symptoms of "Dry Bellyache." Further, since the Jamaican ceramic assemblage was not greatly different from that found elsewhere in the 17th century, the same condition must have prevailed anywhere in the world where these common glazes were used. Lead poisoning may have had an enormous, and largely unrecognized, impact on all these populations. This research serves as a substantial contribution in the development of artifactual analysis as a major tool for lead archaeotoxicology.

Cheryl Ward Haldane, Ph.D.

Cheryl Ward Haldane was awarded the degree of Doctor of Philosophy in May, 1993. She is currently associated with INA-Egypt and co-directs the excavation of the Sadana Island Shipwreck on the Egyptian Red Sea coast. Her dissertation is "Ancient Egyptian Hull Construction." Models, representations, economic and religious texts, and more than 20 actual wooden hulls allow the tracing of nautical technology in Egypt from 5000 to 2500 years ago.

Dr. Haldane concludes that "the picture that evolves is one of dedication to certain principles and of flexibility in the face of need." The ancients would recognize broad, shallow hulls built of thick planks with joggled edges that are still afloat on the Nile. The basic designs, construction methods, and tools used well over 4000 years ago were still in use by traditional Egyptian shipwrights in our own century. These techniques show obvious continuity with methods developed for the construction of wooden hulls with stone tools.

It probably took the equivalent of one laborer working a week of eight-hour days to produce a single plank measuring 4 by 0.2 by 0.025 meters, yet Old Kingdom inscriptions brag of building an entire 30-meter freighter in 17 days. This is impressive testimony of the power of the king to command resources and workers. The famed monumental structures of ancient Egypt represent the efforts of the many shipbuilders needed to construct the large, rounded cargo carriers that transported huge stones and other materials to the building sites.

These large cargo carriers and the narrow, fast hulls buried at Abydos and other sites show that the Egyptian shipwrights of the Early Dynastic period could already provide solutions to diverse problems. The edge-joinery used to hold Egyptian hulls together was also found in coffins, furniture, and other wooden structures at least as early as the First Dynasty. The mortises and tenons used in ship construction, unlike those in furniture, were left unpegged. This allowed hulls to be broken down and reassembled more easily. The lack of pegs meant that ligatures or lashing needed to be used as a supplementary means of fastening the thick planks as they were built up one-by-one around a central section.

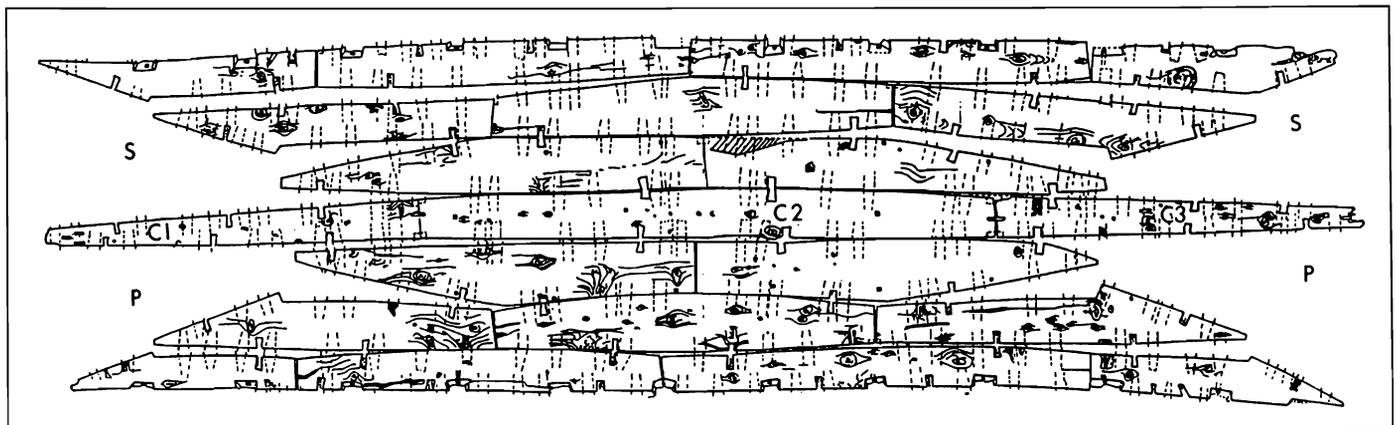
Cargo hulls were built of short planks fashioned from thick slices sawn from a trimmed acacia or tamarisk log. This method (still used in Upper Egypt in the early part of this century) generated little waste. In contrast, ceremonial hulls are longer and more curved, and show evidence of having been formed from much larger pieces of expensive cedar from Syria and modern Lebanon. In cargo vessels, the framework could be heavy, both to support the cargo and to lower the center of gravity to counter the effect of deck cargo. This "skeleton" was only inserted after the planked shell was completed.

Egyptian ships were designed so that as much of the material as possible could be reused. As noted, fastenings were designed so that the planking could be disassembled without damage to the wood. The recycled wood could be used again for shipbuilding; a number of planks and beams from the Dashur boats show evidence of previous use. In addition, the construction ramps and slideways used at temple complexes include hundreds of planks that appear to have been designed for original use in ships and secondary use in construction. The Egyptian bureaucracy kept track of every scrap of wood and every metal tool, and may have required that ships be built with standardized planks that could be used equally for several purposes.

There must have been rigid rules about the shapes and designs that could be used. Many Egyptian ships and models use an identical planking plan. Such standardization had an additional benefit: it allowed the ships to be disassembled by a team in one location, transported across land and then reassembled by a different team. This is well attested from at least the Middle Kingdom right down to the nineteenth century CE. There is evidence that the organization of labor in Egypt was profoundly affected by the need for standardized teams to carry out these projects.

Unfortunately, we have no remains or models, and few detailed representations of Egyptian seagoing ships. The technical challenges involved guarantee that these would have been quite different from the riverine craft. The oldest excavated Mediterranean hull, the Uluburun shipwreck excavated by INA, uses methods of hull construction vastly different from those we know from Egypt. The Egyptian riverine craft were built up around a large flat central strake, while the Uluburun and other Mediterranean seagoing ships had a keel or keel-like plank. The planking on known ancient Mediterranean seagoing hulls is much thinner in proportion to the size of the vessel than in known Egyptian ships, and is held together by pegged mortises. Egyptian shipbuilders avoided having anything pierce the hull below the waterline until around the sixth century BCE, when pegged joints were first used. The discovery of an ancient Egyptian seagoing vessel would answer many questions about the influence of Egyptian shipbuilding practices on shipbuilding in the Mediterranean basin.

As fragmentary as the Egyptian material is, it still provides more information about Bronze Age hull construction, over a longer period of time, than any other source available to us. Dr. Haldane's dissertation shows how much we can learn from this material about the solutions that the Egyptian shipwrights evolved to solve their problems. In many ways, these design and technological features proved as durable as the familiar stone monuments of Egypt.



Carnegie Dashur boat, inner surface of hull planking. The bulwarks are not illustrated. The bow is to the left.

Drawing: C. Haldane

Jerome Hall, Ph.D.

Jerome Hall was awarded the degree of Doctor of Philosophy in 1997. His dissertation is entitled "A Seventeenth-century Northern European Merchant Shipwreck in Monte Cristi Bay, Dominican Republic." The shipwreck involved in this study has been known (and looted) for several centuries, but intensive archaeological work began under Hall in 1991.

This site is often called "The Pipe Wreck" because the cargo largely consisted of at least 4000 clay tobacco smoking pipes. Since many of these bear an "EB" heel stamp, used by the Dutch pipemaker Edward Bird between 1630 and 1665, it had previously been assumed that this was a merchantman headed from the Netherlands to one of the Dutch colonies. The bulk of the dissertation is a catalog, analysis, and interpretation of the cultural materials recovered from the site in 1991 and 1992. These data are placed in their historical context with the goal of determining whether the previously-accepted hypothesis is correct. This research has cast considerable doubt on the theory.

Dr. Hall's research significantly narrowed the possible date of the wreck. A coin from the Santa Fe de Bogatá mint with the New Style Pillar design cannot have been minted before 1651. Other coins from the Potosi mint in Peru indicate a time before 1656, probably in the period 1652-54. This is consistent with the known dates of several of the pipe types found in the wreck.

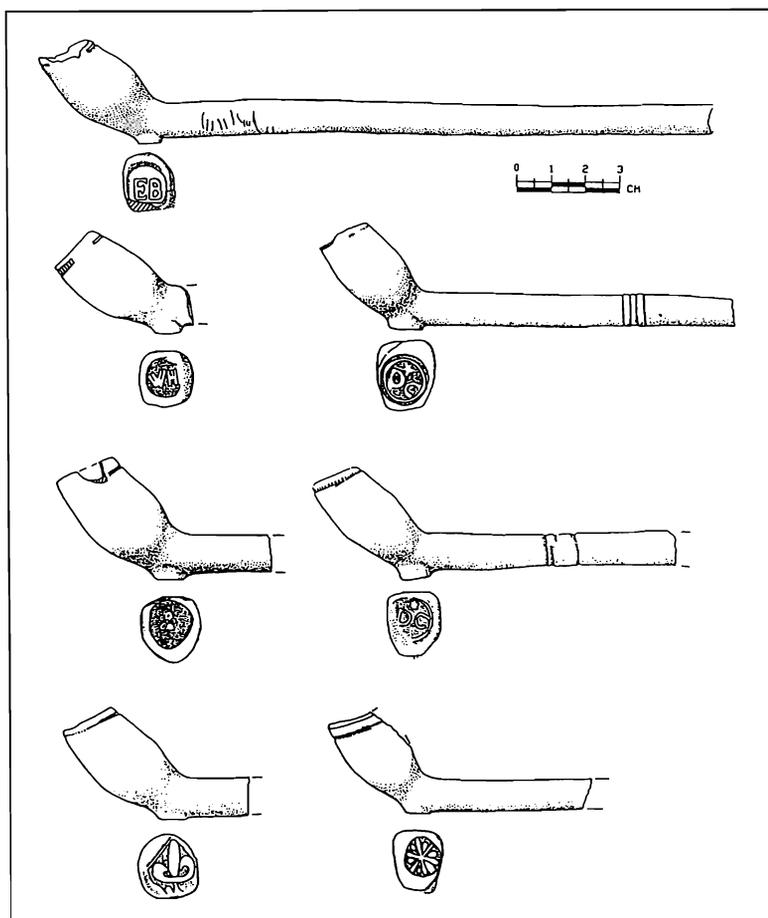
Analysis of the hull wood reveals that the ship was built of English oak. The construction details more closely resemble the *Sea*

Venture, an English ship that sank off Bermuda in 1609, than any known Dutch ship. These facts indicate that the ship was built in England rather than in the Netherlands. There is no clear evidence as to which flag the ship was flying when it wrecked. Dutch pipes are frequent finds in seventeenth-century Anglo-American sites, so they do not point exclusively to a ship from the Netherlands. The faunal remains are those characteristic of an English crew, but the sample is too small to rule out Dutch seamen. The nationality of the ship at the time of its last voyage must thus remain an open question, with the evidence leaning toward English.

Dr. Hall concludes that the common supposition that the Pipe Wreck ship was headed for the Dutch colonies is unlikely to be correct. None of the characteristic items of cargo are present. Particularly suggestive is the absence of the yellow bricks that were usually carried as ballast to the Americas. Instead, there are funnel elbow-angled smoking pipes especially prized by Native Americans. This indicates that the ship was headed for a destination in North America, rather than the Caribbean. The goods found on the ship match those found at the Compton Site in Maryland. The Anglo-American colonies of the Upper South had a close relationship with the Dutch during the period of the English Civil War and Interregnum, despite the Anglo-Dutch Wars. Thus, it seems likely that this ship was headed for the English colonies when it wrecked in Monte Cristi Bay. However, a destination of New Amsterdam cannot be ruled out, since the Native Americans who most prized the pipes were in the upper Hudson Valley, under the aegis of the Netherlands until 1663.

One of the primary lessons that Dr. Hall draws from the "Pipe Wreck" is that England and the Netherlands, and their respective colonies, maintained close commercial contacts notwithstanding the rivalry that sparked the Navigation Acts and the Anglo-Dutch Wars. The wreck also provides insights into trade between the Old World and the New. The large number of funnel elbow-angled smoking pipes indicate the extent to which European manufacturers were willing to tailor their production to the tastes of consumers in the New World. In this case, Dutch manufacturers were responding to the Native American market by meeting New World tastes in smoking equipment. As Dr. Hall concludes, "Regardless of which provisional conclusion is offered to explain its presence and subsequent demise off the coast of Hispaniola, the northern European shipwreck in Monte Cristi Bay lies as a monument to European colonial expansion, maritime commerce, and the important role of tobacco in the New World during the second half of the seventeenth century."

Bulbous-bowled pipes from the seventeenth-century northern European merchant shipwreck in Monte Cristi Bay, Dominican Republic. Seven distinct heel marks (enlarged 2x) are shown.



Drawing: A. Roberts

Frederick M. Hocker, Ph.D.

Frederick Martin Hocker is now the Sara W. and George O. Yamini Faculty Fellow in the Nautical Archaeology Program at Texas A&M University, and Field Director of the INA excavation of a Byzantine wreck near Bozburun, Turkey. He became a Doctor of Philosophy in December 1991. His dissertation is "The Development of a Bottom-Based Shipbuilding Tradition in Northwestern Europe and the New World." This details Dr. Hocker's identification of a major family of boats and ships of bottom-built construction. Part of the dissertation has recently been published in *A small cog wrecked on the Zuiderzee in the early fifteenth century* (Flevobericht, 1996), co-authored with Karel Vlierman.

Traditionally, nautical historians and archaeologists have divided watercraft into two major families: shell-built and skeleton-built. In the shell-built craft, the exterior skin of planking or some other material is the primary component. It is generally built first and provides most of the structural strength to the vessel. Although there is frequently an internal framework to provide additional strength, this is generally inserted into the completed hull as a secondary component. Examples of this family may be found from many areas of both Northern and Mediterranean Europe. Vessels as diverse as the grave boats found in Egyptian tombs and Viking longships were built in some variation of the shell-first form of construction.

In contrast, most modern boats and ships are members of the skeleton-first family. A keel, transverse frames, and longitudinal stringers are built and assembled first to provide most of the strength. The external skin of planking or other material is added later to keep the water out. The elements of the skin are primarily attached to the framework, rather than to each other. The gradual adoption of skeleton-first construction during the medieval period marks one of the most significant transitions in nautical history.

Dr. Hocker noticed that a large number of vessels, largely flat-bottomed and confined to inland or coastal waters, did not go neatly into either category. They seem to mix characteristics of both shell-first and skeleton-first concepts. In fact, they often employ methods that do not seem to fit either family. Indeed, these vessels belong in a distinct, third family of boat and ship construction.

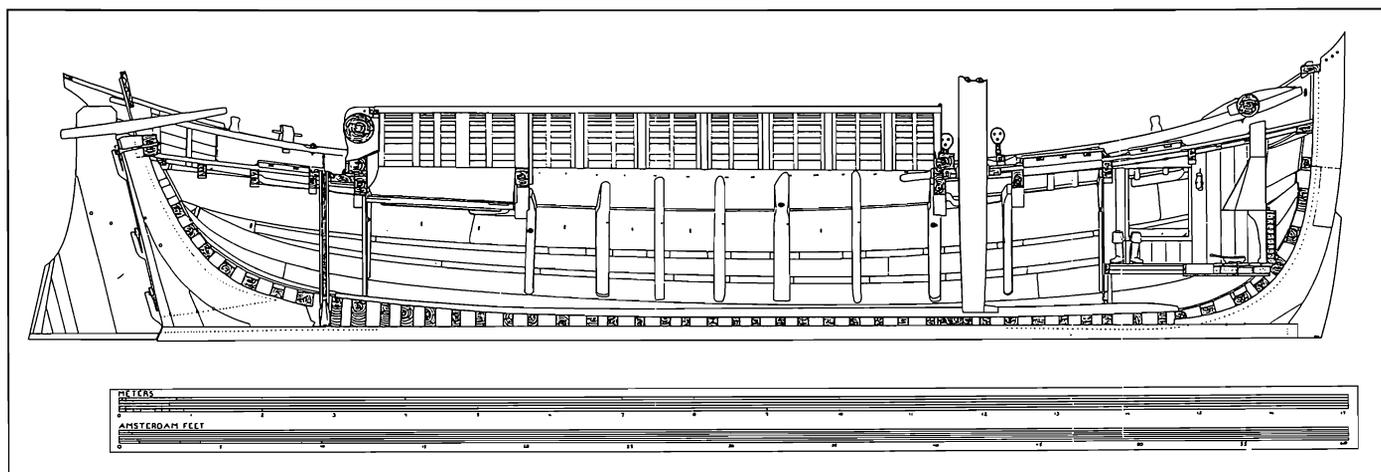
The bottom-built craft are distinguished by a heavy, flat bottom of straight planks. These are temporarily fastened together

as the first step of construction. Ships built in this tradition (and their remains) often show extra holes in the bottom planking attributable to these temporary fastenings. Once the bottom has been shaped properly, the planks are permanently attached to heavy floor timbers. Finally, the sides of the ship are completed over the framework previously erected.

The bulk of Dr. Hocker's dissertation traces the history of the bottom-built tradition from its dim origins before the first description of "Celtic" ships in the *Commentaries* of Julius Caesar. Originally, the sides of a bottom-built ship were generally of overlapping planks riveted or nailed together in lapstrake fashion. This was similar to the planking of the clinker-built ships of the Northern European shell-built tradition, although the shell of bottom-built ships did not need to be as strong, due to the preexisting framework. Eventually, northern shipwrights in the bottom-built tradition adopted the southern custom of planking with boards laid flat edge-to-edge (carvel-built), relying on the framework for all the side strength. This had economic benefits that the Dutch, in particular, exploited in and after the fifteenth century.

Most of the modern survivors of this tradition are relatively small inland and coastal craft. The examples from the Roman era, when the tradition first clearly emerges, are also relatively small compared to the larger contemporary Mediterranean vessels built with edge-joined shell-first techniques. In medieval Northern Europe, however, the bottom-built ship really came into its own. One of the most important ship types of the Middle Ages, the cog, is an example of the bottom-built tradition. Cogs dominated seagoing trade in Northern Europe during the twelfth through fourteenth centuries, and some related inland craft have remained in use down to this century.

In an epilogue, Dr. Hocker describes the influence of the bottom-built tradition of the construction of watercraft in the New World. The Brown's Ferry vessel from tidewater South Carolina is described as an example. Over time, this tradition merged with native and European skeleton-based traditions to produce hybrid vessels well adapted for particular uses. Thus, the third family of watercraft continues to have an influence on boatbuilding on both sides of the Atlantic.



Oost Flevoland B 71 Longitudinal Construction Section, just one of Dr. Hocker's drawings presented in his dissertation.

Margaret E. Leshikar, Ph.D.

Margaret Elaine ("Peggy") Leshikar received the degree of Doctor of Philosophy in December, 1993. Her dissertation is entitled, "The 1794 *Wreck of the Ten Sail*, Cayman Islands, British West Indies: A Historical Study and Archaeological Survey." She presents the history, archaeology, and folklore associated with an incident on 8 February 1794, when His Majesty's Frigate *Convert*, and nine of the fifty-eight merchantmen it was escorting (fifty-five from Jamaica to Britain, and three to North American ports *en route*) wrecked on the reefs to windward of the East End of Grand Cayman Island. The dissertation ties together information gathered from archival research in Jamaica, Britain, and France; survey and mapping of shipwreck sites on the Cayman reef; and oral history interviews with older Caymanians.

The archival research results concentrate on the *Convert*, which had been captured from the French as recently as November 1793. The broader context of the disaster was the series of wars between Great Britain and revolutionary France, which were (in effect) world wars extending to the overseas possessions of both combatants. The French twelve-pounder frigate *l'Inconstante* was one of the casualties of this conflict when it was captured off the French West Indian colony of St. Domingue, now Haiti.

The frigate *l'Inconstante* was under construction at Rochefort in 1789 when the French Revolution broke out, and was not ready for service until nearly the end of 1791. From 12 April 1792 through 25 November 1793, the ship served with the French Caribbean squadron based in St. Domingue. The ship's life as a French man-of-war ended when it was captured by two British ships and sold to the Royal Navy as a prize. Since there was already an H.M.S. *Inconstant*, the ship was renamed *Convert*.

The first mission of the new British warship was to escort a convoy of fifty-eight merchant ships. Two days after the convoy sailed, a series of mishaps and miscalculations sparked by an unusually strong current led to the loss of *Convert* and nine ships of her charge (hence "Ten Sail") on the Grand Cayman reefs. There were only eight fatalities, and most of the people continued their interrupted journey on other ships of the convoy. Despite considerable efforts at salvage, most of the cargoes were lost.

The oral history research revealed an additional dimension to the story. *The Wreck of the Ten Sail* has remained a significant event in Caymanian folklore down to the present day. The stories are not entirely consistent with the historical or archaeological record, but nonetheless form the most important of Cayman's many wrecking tales.

An archaeological survey revealed thirty underwater and eight terrestrial sites from the late eighteenth to twentieth centuries in the area where the convoy wrecked. Two of the underwater locations seem to represent some of the French cannon from the *Convert*, and an area of spillage from the frigate, while one of the terrestrial sites seems to be the salvage campsite. A number of the other loci may be associated with the merchant vessels from the *Ten Sail* catastrophe.

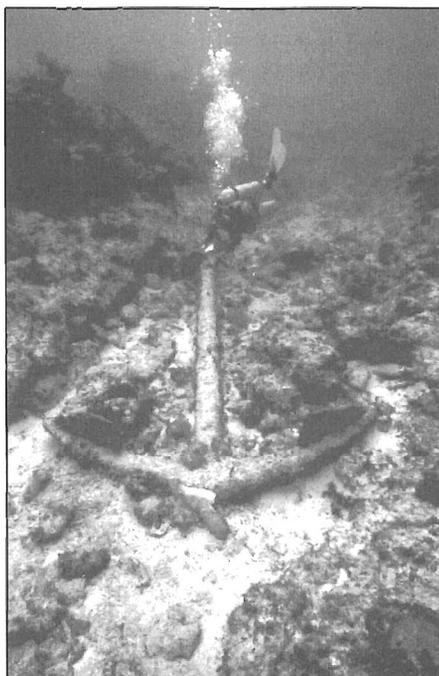
Few vessels from the 1792-1815 period have been archaeologically studied, so the *Wreck of the Ten Sail* has the potential to provide a valuable physical record of the era. In particular, further investigation of the merchant ships might help throw light on Britain's commercial activity during this important period. The information and artifacts would provide the foundation for interpretive displays that could educate and inform both Caymanians

and visitors about an important part of eighteenth-century history and folklore.

Since writing this dissertation, Dr. Leshikar has had an opportunity given to few of us, to follow her own advice. She is now the Museum Archaeologist for the Cayman Islands National Museum. In that capacity, she has been able to share her scholarship with the Caymanian people. The data from the dissertation formed the basis for the Museum's two-hundredth anniversary exhibition that opened in February 1994. The exhibit, which was viewed by Her Majesty Queen Elizabeth II and His Royal Highness Prince Philip, formed the centerpiece of a celebration that included art contests and commemorative coin and stamp issues. Dr. Leshikar's dissertation was the basis of her book, *The Wreck of the Ten Sails* (Georgetown, Grand Cayman, 1994). Further work on the *Ten Sail* sites is anticipated when larger conservation facilities have been constructed.



Photo: Dennis Denton



Above: Aerial view of the reefs where the Wreck of the Ten Sail occurred.

Left: An archaeologist examines a probable eighteenth century Wreck of the Ten Sail anchor.

Photo: Mike Guderian

Robert S. Neyland, Ph.D.

Robert Stephen Neyland received the degree of Doctor of Philosophy in August 1994. He is now an INA Research Associate and Head of the Underwater Archaeology Branch at the Naval Historical Center, Washington Navy Yard. Dr. Neyland's dissertation is "Technological Continuity and Change: A Study of Cultural Adaptation in Pram-Class Boatbuilding in the Netherlands." This traces the development of an ancient class of Northern European watercraft with flat bottoms and hard chines at the turn of the bilge. Although these vessels are known by a variety of local names, the best-known is the English term "pram" (in Dutch, *praam*). Dr. Neyland refers to the broader collection of vessel types as "pram-class." The research presented in this study deals primarily with archaeological examples from the Netherlands.

The pram falls into the bottom-based tradition of shipbuilding, as opposed to either the shell-based or skeleton-based traditions. In the pram-class vessels, there is no distinct keel or keel plank, although there may be a central plank with skegs fastened underneath and rectangular toes in the bow and stern for mounting the raking endposts.

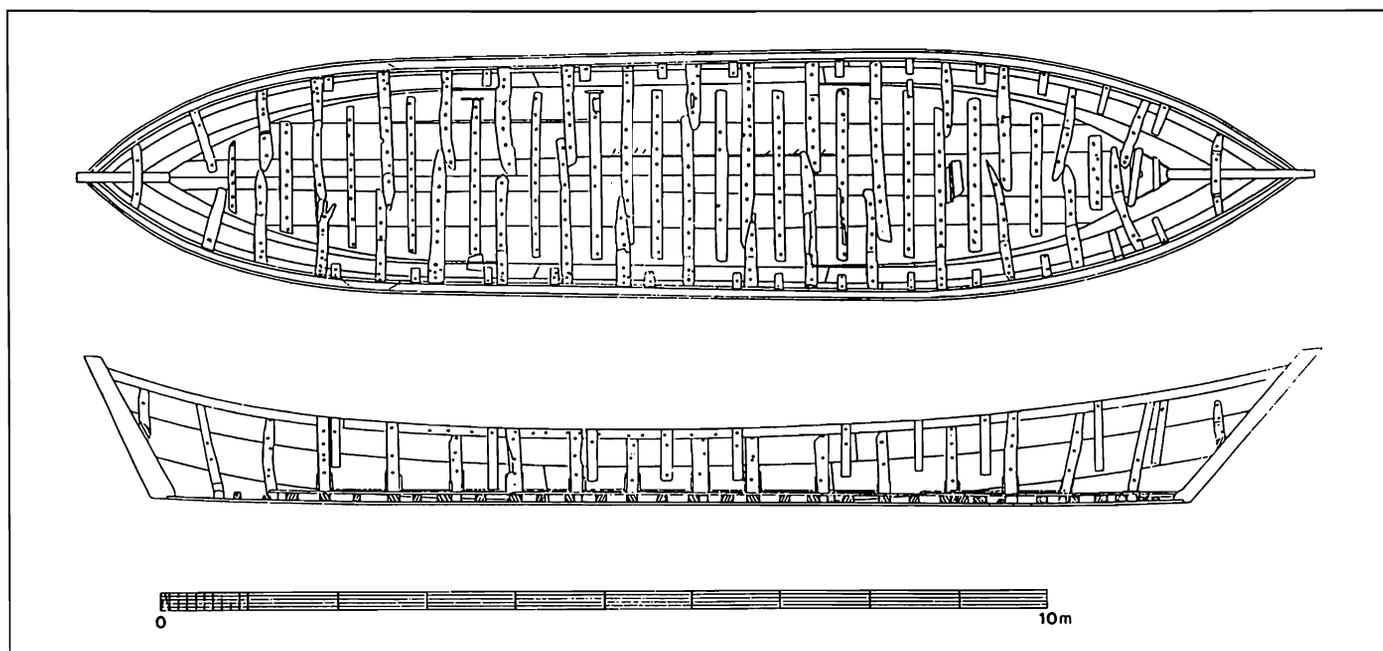
The flat bottom and narrow hull of the Netherlands pram-class vessels reflect the environment in which they evolved. The key to the development of the Netherlands, and of the pram-class vessel, was the presence in the heart of the country of the inland body of water that developed from the freshwater Flevomere of Roman times, through the brackish Almere of the earlier Middle Ages, to the tidal Zuiderzee by the late Middle Ages (particularly after the St. Elizabeth's Flood of 1421). In 1932, it again became the freshwater IJsselmeer after the construction of a 19-mile barrier dam. Polders, reclaimed areas of the lakebed, are where most of the pram-class vessels studied by Dr. Neyland were found. The design of these watercraft allowed them to operate safely in the shoal waters of the Almere and Zuiderzee, as well as in the narrow waterways that connected them to the North Sea, Rhine, and Scheldt.

Dr. Neyland describes the ancient predecessors of the pram, the Zwammerdam vessels and other Roman bottom-built boats of

the Rhine and its tributaries. These share many of the characteristics of the pram class, including a flat carvel-laid bottom, hard chines with near-vertical sides, and the use of L-shaped frames. It is hard to assume direct historical continuity, however. During the Dark Ages after the Roman withdrawal, the area of the modern Netherlands reverted to a nearly unpopulated wetland. There are no known post-Roman watercraft remains of any sort in the Netherlands before the eleventh century. The oldest surviving examples of the pram class were found in an old course of the Rhine at Meinerswijk near Arnheim. These two vessels date to about the thirteenth century, nearly a thousand years after the similar Roman examples. The larger of these vessels may have been 25 meters in length. This vessel indicates the growth in available capital that could be invested in tools and materials, as well as the increased availability of laborers with specialized skills.

During the thirteenth and fourteenth centuries, prams were used as coasters, lighters, and transports in the shoal waters of the Almere, where larger cogs could not sail. This allowed transshipping merchandise from the inland provinces of the Netherlands to the deep water ports on the Scheldt or North Sea. In the late fifteenth century, the rising sea levels that formed the Zuiderzee also created a crisis for farming in the Netherlands. Many of the Dutch sought a living on the water at sailing or fishing (a colder climate after 1400 forced the major herring shoals from the Baltic to the North Sea). Virtually every village had access to the sea via the inland waterway network, so shipping and trading became important secondary occupations even for those who still primarily worked in agriculture. The pram-class vessel played an important part in this process, which eventually led the Netherlands to its status as a world power in the sixteenth through eighteenth centuries.

The type continued its evolution during these centuries. Fore-and-aft sails came into common use in the fourteenth century, enabling the craft to sail much closer to the wind and even tack upwind (given enough running room). The combination of greater efficiency and shorter sailing times represented a major savings



WN 92 construction plan, just one of many vessels studied by Dr. Neyland.

Drawing: R. S. Neyland

in labor costs. This provided important advantages during the European population decline that began in the fourteenth century. Some small ships found from this period combine the features of the pram with a finer entrance and run for increased speed and stability, without losing the advantages of shallow draft and high capacity given by the nearly rectangular cross-section amidships. This may have been motivated, in part, by the transformation of the Zuiderzee into an arm of the North Sea, requiring more seaworthy designs.

In the sixteenth and seventeenth centuries, the Netherlands enjoyed their golden age. The experience of the Dutch with shipping and commerce allowed them to reap the benefits of the new global exchange economy. Again, pram-class vessels played an important part in this economic boom. They carried the peat fuel for industry, and all the other bulk cargoes that required transport on the inland waterways or coastal waters. The invention of leeboards (oval planks on both sides of the hull that could be lowered into the water as needed to prevent leeway) considerably increased the tacking abilities of shallow-draft vessels with flat bottoms. Many variants of the pram were developed, from small vessels with fine lines to much larger freighters with a bluff bow and stern on an almost rectangular outline.

James Michael Parrent, Ph.D.

James Michael Parrent was awarded the degree of Doctor of Philosophy in Anthropology in 1990. His dissertation, entitled, "Management of Historic Ship Archaeological Sites in the Caribbean" attempts to address one of the most severe problems for maritime archaeology—the destruction of sites by treasure hunters. The rich diversity of Caribbean cultures makes the region a world resource for archaeology. Regional sites preserve the evidence for the European discovery, exploration, and settlement of the New World. Treasure hunters who view sites as bank vaults to be looted pose the greatest danger to this invaluable part of the regional and world heritage.

Archaeology is one of the few sciences that destroys what it studies. The only excuse for the excavation of a culturally-important site is that responsible researchers preserve and publish every scrap of information that the state of the art will allow. A treasure-hunting expedition cannot possibly take the time necessary to do this, and still provide the maximum return to investors. As Dr. Parrent says, "profit and archaeology are mutually exclusive terms."

The Caribbean area has suffered some of the worst damage, since it is a prime target for treasure-hunting ventures. Many of these ventures have operated clandestinely, on the fringes of the law or flatly against the law. Other treasure hunters have chosen to seek contracts with island governments. Treasure hunters tend to be far better at public relations than archaeologists are, since the hunters must seek publicity in order to attract investors. Furthermore, treasure hunters are not bound by professional standards that limit their claims and promises. Archaeologists are therefore at a disadvantage in dealing with host governments that are subject to popular and political pressures (to say nothing of economic pressures that might be alleviated by "a cut of the action").

Regardless of the avenue chosen by the treasure hunters, the results are the same: the irretrievable loss not only of valu-

After 1650, the Netherlands, although still a world power, went into a long period of stagnation and ultimate decline. The small nation had become overextended, and suffered from naval defeats, expensive colonization efforts, foreign competition, and trade barriers. Several small pram-class vessels from this period have been excavated, showing the changed emphasis on small specialized workboats to transport peat, mud, or night-soil. There were also larger vessels designed to travel short distances across the Zuiderzee or through the canals to industrial centers or the Scheldt. These late pram-class vessels show signs of having been built with poor timber on a very tight budget.

Dr. Neyland concludes that the pram-class watercraft must be studied in conjunction with the society that used them. Nautical archaeology cannot content itself with a simple description of the technical details of ship construction or with catalogs of artifacts. It must develop theoretical models that will allow a greater understanding of the significance of watercraft for the societies that used them. Ship construction designs, and particularly the development of new techniques, are the result of adaptation to evolving economic, cultural, environmental, and technological factors. In order for the discipline to mature, nautical archaeologists must be willing to see and study these broader considerations.

able artifacts, but still more of the everyday objects, trace evidence, and provenience data that are the soul of archaeology, but irrelevant to a treasure hunter. We have all seen the television programs celebrating the exploits of men who tear a site to shreds with their prop wash in order to expose the gold that *might* be there. When they are done, nothing is left intact or in its original location.

Even if the treasure hunters hire an "archaeological consultant," there are rarely any financial provisions made for adequately recording the site; for conservation and perpetual curation of the artifacts without commercial value; for peer-reviewed research by experienced technical experts, archivists, historians, and other specialists; or for publication of the recorded data and final conclusions. All of that takes time, trouble, and money that a treasure hunter cannot easily pass along to his investors. The host country may receive short-term economic benefits from dealing with treasure hunters, but the long-term cost is the loss of the local cultural heritage.

The Caribbean nations seeking to develop their cultural resources do not have to rely on treasure hunters. Dr. Parrent suggests these countries should enact legislation that clearly establishes ownership of historic ship archaeological sites. Then they should adopt cultural resource management plans that consider site preservation, ecological impacts from excavation, and professional standards for the recovery, conservation, study, and display of artifacts. Governments can contract with universities and non-profit organizations to provide the expertise and experience essential to deal with historic shipwreck sites, while simultaneously providing for the on-site training of local scholars and archaeological workers. This will allow the Caribbean nations to act as faithful stewards of the portion of the world heritage that has been committed to their charge.

Cemal M. Pulak, Ph.D.

Cemalettin Mustafa Pulak is well-known to *INA Quarterly* readers as the Director of the later stages of the excavation of the Uluburun Bronze Age ship. He was awarded the degree of Doctor of Philosophy in December 1996 and (as of the 1st September 1997) will be Assistant Professor and Frederick R. Mayer Fellow in the Nautical Archaeology Program at Texas A&M University. His dissertation is "Analysis of the Weight Assemblages from the Late Bronze Age Shipwrecks at Uluburun and Cape Gelidonya, Turkey." This will be published as part of a multi-volume excavation report.

Since we live in a world in which virtually all nations have adopted a single system of weights and measures, it is hard to imagine the chaos that prevailed before. Units of length, capacity, and mass differed not only from one country to another, but even from city to city, and almost from shop to shop. The only way to recover these ancient systems is to study the artifacts that incorporated them.

For convenience, most objects were (and are) designed to incorporate either an integer multiple of the basic unit, or some simple fraction of the unit. Given enough examples, it is possible to deduce the size of the basic units in terms of the metric standard. For example, someone who walked into a modern American bakery and weighed every loaf of bread could quickly establish that most of them were related in some way to a unit of mass approximately equal to 0.45 kilogram. It would probably also be possible to deduce that this unit was commonly divided into smaller units equal to 1/16 of the basic unit. This dissertation performs the same sort of analysis on pan-balance weights from the Late Bronze Age to determine what units of mass were in use on these two ships.

Fortunately, the fourteenth-century Uluburun and thirteenth-century Cape Gelidonya shipwrecks provide an adequate sample. The assemblages of pan-balance weights from these sites are by far the largest and most complete collections of Late Bronze Age weights recovered from individual archaeological sites. A total of 149 specimens were recovered from the Uluburun ship and 62 from Cape Gelidonya.

The collections are notable not only for their size, but also for their nature. Because all the weights in a shipwreck are deposited together into a sealed context, the excavator can be certain that they were used concurrently. Researchers of terrestrial sites can rarely be sure of this. Since weights and measures may change over time, it becomes much harder to be certain that pan-balance weights intended to represent the same unit of mass will actually have the same mass. For example, Dr. Pulak's research indicates an increase of more than 1.2% in the standard mass unit during the century between these two Bronze Age wrecks.

The overwhelming bulk of the pan-balance weights found in both shipwrecks use a standard mass unit equal to approximately 9.3 grams. The Uluburun assemblage includes no less than four complete sets of sphenonoid (sling-bullet-shaped) weights in integer denominations of this basic unit. Virtually all of the domed weights found in the wreck conform to this same standard. The larger units in the 9.3 g system seem to have been related to the basic unit according to a decimal hierarchy. It appears that the domed weights were used for everyday weighing of bulk commodities that did not require great precision, while the sphenonoids were used for the accurate weigh-

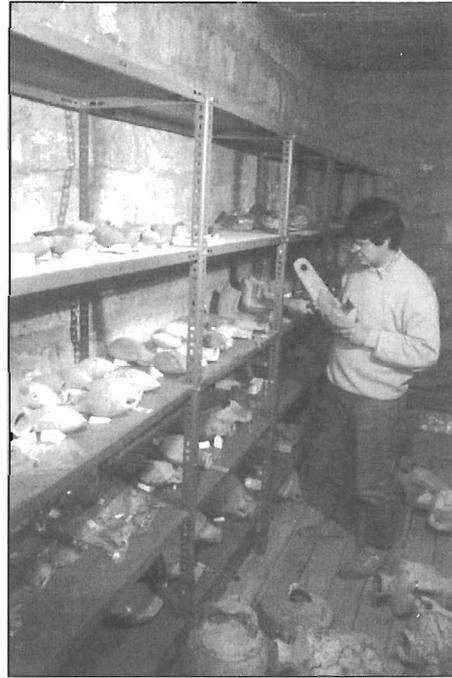


Photo: INA

Dr. Pulak at work on some of the many artifacts from the Uluburun Bronze Age shipwreck.

ing of valuable objects such as precious metal, valuable stones, and spices (all of which have been found in the Uluburun wreck).

Likewise, the Cape Gelidonya weights incorporate the same decimally-structured norm based on a unit mass of about 9.3 g. Both the sphenonoid and domed weights seem to have been used for the same purposes, as both types include only integer multiples of the basic unit, and both types range up to weights with a mass equal to 50 basic units. The century between the two wrecks was one of economic decline in the Mediterranean world, and this may be reflected by the slight inflation of the basic unit. The Cape Gelidonya weights average 1.2% heavier than the Uluburun weights. This may be due to the absence of precision weights from the later set, or due to the economic depression.

Secondary weight standards are not completely absent from either shipwreck site. The Uluburun wreck yielded sets that followed basic units of about 8.3 g and 7.4 g. Some irregularly-shaped domed weights from Cape Gelidonya seem to conform to a standard mass of between 7.1 and 7.3 g. The three sphenonoid sets from Cape Gelidonya that follow the 9.3 g standard lack 10-unit weights. Instead, each set has 7-unit pieces of approximately 65 g, and there are three additional weights of the same mass. This is initially puzzling, until one realizes that the 7-unit weights are also approximately equal to the basic unit of the 61 g system used in the Aegean by the Mycenaean. Thus, these scale weights could be used for both systems.

Before the development of government-sponsored standard measures and government-guaranteed coinage, each party to a transaction would use their own scales to guarantee that the value given was not too heavy and the value received was not

too light. Scales and their attendant weights were thus an essential form of personal property for everyone who had business in a public market. Merchants would trade with their own weight sets based on the mass standards to which they were most exposed. For this reason, scale weights are crucial indicators of the nationality of the persons who used them.

It is therefore significant that none of the weight sets on either of these ships followed primarily the 61 g system used on land in the Aegean during the Late Bronze Age. Although there were at least two Mycenaean on the Uluburun ship, they were probably officials or envoys accompanying an immensely valuable royal shipment back to their home port. They were apparently not merchants carrying their own scales. The overwhelming majority of the weights on both ships complied with the 9.3 g standard in use along the Syro-Palestinian coast and on Cyprus. Thus, the weight assemblages suggest that both vessels had primarily Syrian or Cypriot merchants aboard. That this was true of two ships about a century apart would seem to indicate the importance of these merchants near the end of the Late Bronze Age.



Photo: INA

A pan-balance weight in the form of a sphinx from the Uluburun shipwreck.

C. Wayne Smith, Ph.D.

C. Wayne Smith, who is the director of the Archaeological Preservation Research Laboratory at Texas A&M and will be an Assistant Professor in the Nautical Archaeology Program from the 1st September 1997, received the degree of Doctor of Philosophy in May 1995. His dissertation is "Analysis of the Weight Assemblage of Port Royal, Jamaica," which will shortly be published in the BAR series. This is a study of the 90 weights recovered to date from the excavations at Port Royal. Dr. Smith uses the weights as a jumping-off-place for his study of a surprisingly wide range of issues relating to life in the seventeenth century.

Approximately thirty-two acres of the colonial community of Port Royal sank into Kingston Harbor during an earthquake on 7 June 1692. Layers of silt and a protective layer of staghorn coral have encased the site for most of the past three centuries, protecting it from both human and natural dangers. As a result, the site provides one of the best windows into the 17th century, not only for the study of colonial culture, but also for the study of English and European culture as a whole.

These conditions have been particularly beneficial for the preservation of the scale weights used in commerce and industry. Lead weights were soft and easily damaged, in which case they were generally recycled. The weights had an intrinsic value as material for musket balls and other armament, so they were frequently melted down for reuse. For these and other reasons, lead and bronze weights have not survived in anything like the numbers that archival records suggest should be present at European or colonial archaeological sites. Due to the sealing of the site, Port Royal is an exception.

Dr. Smith's dissertation includes a descriptive catalog of the recovered weights, necessary for further study of the artifacts, as well as for planning future work and curation. However, the bulk of the paper deals with more analytical issues.

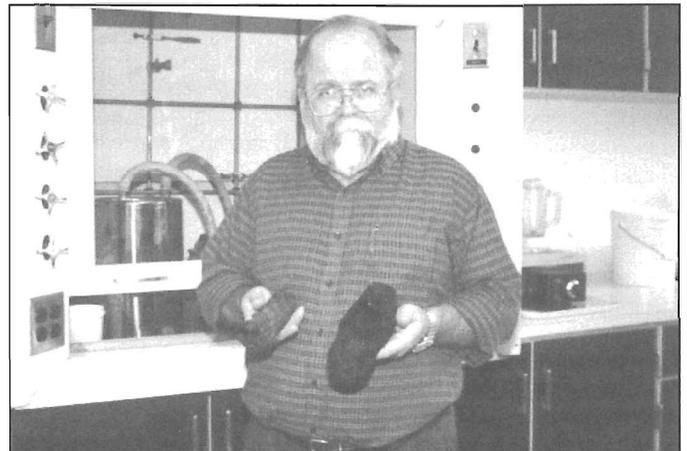


Photo: C. A. Powell

Dr. Smith holds two artifacts from the La Salle shipwreck that are currently undergoing silicone conservation treatment under his direction.

The distribution of weights and other archaeological materials at Port Royal is used to better understand the functions and uses of the buildings that have been investigated. For example, the particular assemblage of weights found in Building 5 suggests that it was in part a tavern including a bakery. One weight is 55 pounds avoirdupois, which was the standard mass of a bushel of wheat. There were also 7 and 9 pound weights, which were standard masses for loaves of bread.

Dr. Smith provides a history of the development of standardized weights and measures in England and its colonies. This involved several competing metrological systems. This led to the famous riddle: "Which weighs more, a pound of feathers or a

pound of gold?" The answer is "feathers," which were sold according to the avoirdupois pound, which is 22% heavier than the troy pound used by goldsmiths. The simultaneous use of both the standard European weight standards gave England a mercantile advantage over countries that used only troy or avoirdupois exclusively. Weights in England were loosely guaranteed by the guilds until 1670, when King Charles II directed that a King's Beam with standardized weights should be set up in every public marketplace. This system was in the process of implementation in Jamaica at the time of the Port Royal disaster.

The King's Beam used bronze weights as the standard. Perhaps as a result, many lead weights found their way to the colonies. Lead weights predominate in the Port Royal assemblage to a degree that would not have been expected from the British evidence. The number of weights is also suggestive. Most households kept their own scales and weight sets to check on merchants who might sell light and buy heavy. Indeed, many kept two sets, a light one for making sales and a heavy one for making purchases. Weights and scales ("steelyards") are often mentioned in English and Jamaican probate inventories, since they were valuable heirlooms to be passed along from one generation to the next.

Dr. Smith describes the complex system of marks found on some Port Royal weights. The most common marks were a monarch's mark with an orb or crown over an initial, a dagger and shield signifying the City of London, an insignia stating the weight's standard (for example "A" for avoirdupois), the mark of the certifying guild (for example, an angel on lead weights for the Plumbers Guild, and a laver or ewer on bronze weights for the Worshipful Company of Founders), and various owner's marks. The dissertation includes a lengthy discussion of one of the most prevalent marks, the Archangel Michael.

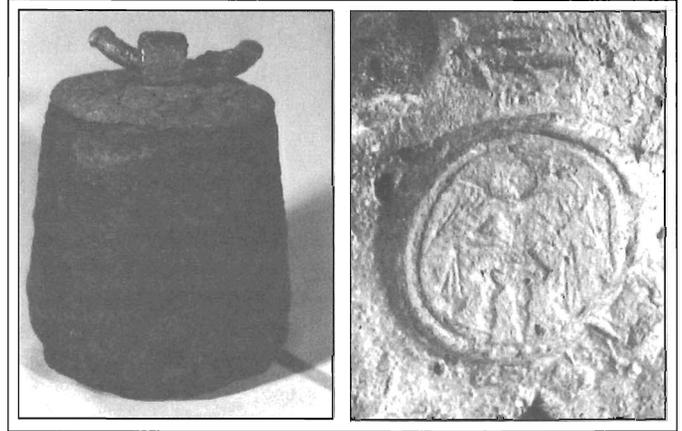
Eri Nattan Weinstein, Ph.D.

Eri Nattan Weinstein received the degree of Doctor of Philosophy in the Anthropology program in 1992. His dissertation is "The Recovery and Analysis of Paleoethnobotanical Remains from an Eighteenth Century Shipwreck." This describes the methodology and results of an innovative study of the fill material excavated from the collier brig *Betsy*. This was one of the vessels scuttled by General Lord Cornwallis in October 1781 during the Battle of Yorktown.

Botanical remains such as macrofossils and pollen can provide substantial information about the use of an archaeological site. Because of the special problems of underwater collection, efforts to collect samples of these materials from a shipwreck are usually limited to sampling the contents of containers and a few other locations of special interest, such as protected parts of the hold or bilges. The *Betsy* excavation, however, presented the possibility for another approach. Due to turbulent local conditions, the wreck site was enclosed by a cofferdam, so that excavation could proceed in calm, filtered water. This protected the fill material from contamination or disturbance during the excavation process. Further, the plan at the time of excavation was to remove all of the fill material from the surviving bow, starboard side, and stern for the purpose of reconstructing the hull. It was therefore decided that 100% of the fill could be examined, in-

stead of small samples. A total of 237 cubic meters of fill was tested during the 1986–88 seasons.

Less than 1% of the weights recovered from Port Royal were illegal or inaccurate. Many of the weights show signs of having been adjusted to the standard used by the King's Beam at the market. Most of them bear cipher marks showing their approval by the London guilds. This indicates that Jamaica largely adhered to the standard set in the metropolis. This part of the city appears to have been composed of well-to-do house/shops, so it is possible that poorer quarters would have had a different assemblage with a higher proportion of illegal weights. Further excavations at Port Royal may eventually answer that question. Dr. Smith suggests a number of avenues for future research.



Photos: INA

A pail-shaped lead weight bearing a number of well preserved marks, including the Archangel Michael stamp (enlarged, right), which may have identified the Plumbers Guild or a particular shop.

This approach allowed the recovery of extensive cask fragments, macrofossil remains, and pollen. These were distributed in meaningful, non-random patterns. The material provided a great volume of data about the stowage and composition of the cargo. There were considerable quantities of corn cobs, poorly cleaned oats, and grass pollen, suggesting that *Betsy* may have been used as a horse transport at some time prior to her sinking. There were also a large number of peach, plum, and cherry stones. These were among the most common fruits in colonial Virginia and were probably used to feed the troops transported in the ship prior to the battle, and the sailors and officers billeted aboard during the siege. The wine bottles aboard were virtually free of macrofossils or pollen, suggesting that they may have been used for rum, rather than wine.

Dr. Weinstein's research, published in the *Final Report on the Yorktown Shipwreck Archaeological Project* (1996), provided valuable information about the use of this ship during the climactic battle for American independence. It further demonstrated the potential value of future exhaustive studies of shipwreck fill for paleoethnobotanical remains and other very small forms of archaeological evidence.

The Culminant Works

Nautical Archaeology Theses and Dissertations as of December 1996

Since 1976, the Institute of Nautical Archaeology has been associated with Texas A&M University in College Station, where many INA faculty also teach within the Nautical Archaeology Program of the Department of Anthropology. The interaction between the two organizations has been extremely fruitful, not least because so many Nautical Archaeology graduate students have participated in INA projects. Unlike many academic programs, the Nautical Archaeology Program at A&M encourages its students to carry out independent research and publish it under their own names. The depth of the work performed by A&M students is reflected in the documents that culminate their academic experience: the master's thesis or doctoral dissertation.

The following compendium summarizes the abstracts and conclusions of eighty-six theses and dissertations submitted since 1978 (a few of these were outside the Nautical Archaeology Program, but on nautical themes for a degree through the Department of Anthropology; summaries that appeared in the 1985 Winter issue [12.3] are only cited by reference). A look at the authors' names will show how many of these students have gone on to distinguished careers in nautical archaeology or related fields. Many are still associated with INA in some way. A look at the titles will reveal the world-wide scope of our discipline.

In addition to the short summaries that follow, the eleven dissertations also receive longer treatments elsewhere in this issue. It should be noted that all these summaries were prepared by the editor, not the authors. Again, in the event that anyone's work has been overlooked or imprecisely summarized, please accept our apologies.

Surveys

Baker, James. "Computers and Nautical Archaeology: Characterization of the C.S.S. *Georgia* Wreck Site" (1982). A Civil War period Confederate ironclad vessel in the Savannah River (see *INA Newsletter* 12.3, 8).

Cowin, Margaret. "Artifacts Recovered off the Southwestern Turkish Coast by Institute of Nautical Archaeology Shipwreck Surveys in 1973 and 1980" (1986). Each year the Institute of Nautical Archaeology (INA) conducts a survey of sites along the Turkish coast line. This is part of INA's continuing quest to expand our knowledge of the area and to learn more of the culture of past peoples. Cowin studied fifty-nine miscellaneous artifacts which were recovered during the 1973 and 1980 surveys in order to date each site. The bulk of material is Hellenistic to Byzantine, but the entire collection extends from a twelfth-century BCE skyphos to a fifteenth-century CE glazed Mamluk fragment. This demonstrates the long history of sea trade in the area. The proportional numbers of certain artifacts underline two well-known features of ancient commerce in the area: the general vigor of Hellenistic trade, and the strength of Rhodes as a mercantile center.

Indruszewski, George. "A Comparative Analysis of Early Medieval Shipwrecks From the Southern Shores of the Baltic Sea" (1996). Although most shipwrecks discovered on the southern shore of the Baltic Sea have been attributed to Scandinavian or Germanic origin, Indruszewski argues that the technical details of these wrecks reveal a distinct regional shipbuilding tradition. The shipwrecks seem to match the characteristics attributed to Wendish ships in historical sources. He concludes that these shipwrecks should be regarded as products of a Slavic shipbuilding tradition that showed its full potential during the eleventh and twelfth centuries. The difficulties in tracing the origins and evolution of this tradition with the available, poorly dated material reveals the need for further research that will be essential for tracing the interaction of the maritime societies of the medieval Baltic.

Inoue, Takahiko. "A Nautical Archaeological Study of Kublai Khan's Fleets" (1991). In 1274 and 1281, the Mongol leader and Emperor of China, Kublai Khan, assembled and dispatched large invasion fleets from Korea in unsuccessful attempts to conquer Japan. Although there are many general works in the literature that discuss these campaigns, there are no detailed studies of the ships themselves. Since Chinese ships may have been the most advanced seagoing vessels in the world at the end of the thirteenth century, this is a major gap in our knowledge of maritime history. This thesis collects, analyzes, and interprets all the available information from both historical and artistic representations. Inoue concludes that the discovery and excavation of one or more of the many sunken ships from these fleets would greatly expand our knowledge of the history of East Asian ship types and design.

Lakey, Denise C. "Shipwrecks in the Gulf of Cadiz (Spain): A Catalog of Historically Documented Wrecks from the Fifteenth through the Nineteenth Centuries" (1987). INA and the Spanish Ministry of Culture conducted an underwater archaeological survey of the Bay of Cadiz from April 1984 through July 1985. In order to facilitate this survey, it was necessary to compile all the available archival and other historical information on shipwrecks known to have occurred in the bay. This thesis lists more than 400 such shipwrecks. It includes not only the sources



Photo: INA

Whenever possible, the latest technology is utilized on INA surveys.

consulted for each wreck, but also the documents and publications those sources used, thus providing a base for additional research. In addition, the thesis discusses the questions that must be answered in order to compile such a catalog, and relates the results of the field survey to the historical information presented in the catalog.

Marquez, Carmen. "Cultural Contributions to the Island of St. John, United States Virgin Islands: Underwater Historical Archaeology at Cruz Bay" (1995). Cruz Bay was the principal port of the Danish colony of St. John from 1733 until the Virgin Islands were purchased by the United States in 1917. After St. John became a free port in 1764, ships of various nations periodically called at Cruz Bay to trade. The Danish West Indies were also a center of the slave trade; servitude was not abolished until 1848. This thesis describes a three-week underwater survey of the area where the historical wharf structures were assumed to be located. Although these were not found, many artifacts were recovered (despite intensive modern use of the area, including heavy ferry-boat traffic). The remains from the lowest cultural stratum included glass bottles, ceramic pipes, and plates, mostly of 18th or 19th-century English origin. These suggest that the English—rather than the Danes—controlled the commerce and everyday life of the island.

Shuey, Elizabeth. "Underwater Survey and Excavation at the Ancient Port of Gravisca, Italy" (1978). The first master's thesis completed through the Nautical Archaeology Program; locates the Etruscan port of Tarquinia and the Roman port of Gravisca at modern Porto Clementino, Italy (see *INA Newsletter* 12.3, 8).

Slane, Dorothy A. "The History of the Anchorage at Serçe Limani, Turkey" (1982). The anchorage was in use from 3000 BCE to the thirteenth century CE. The frequency of use and the nationalities of the users varied with time (see *INA Newsletter* 12.3, 8).

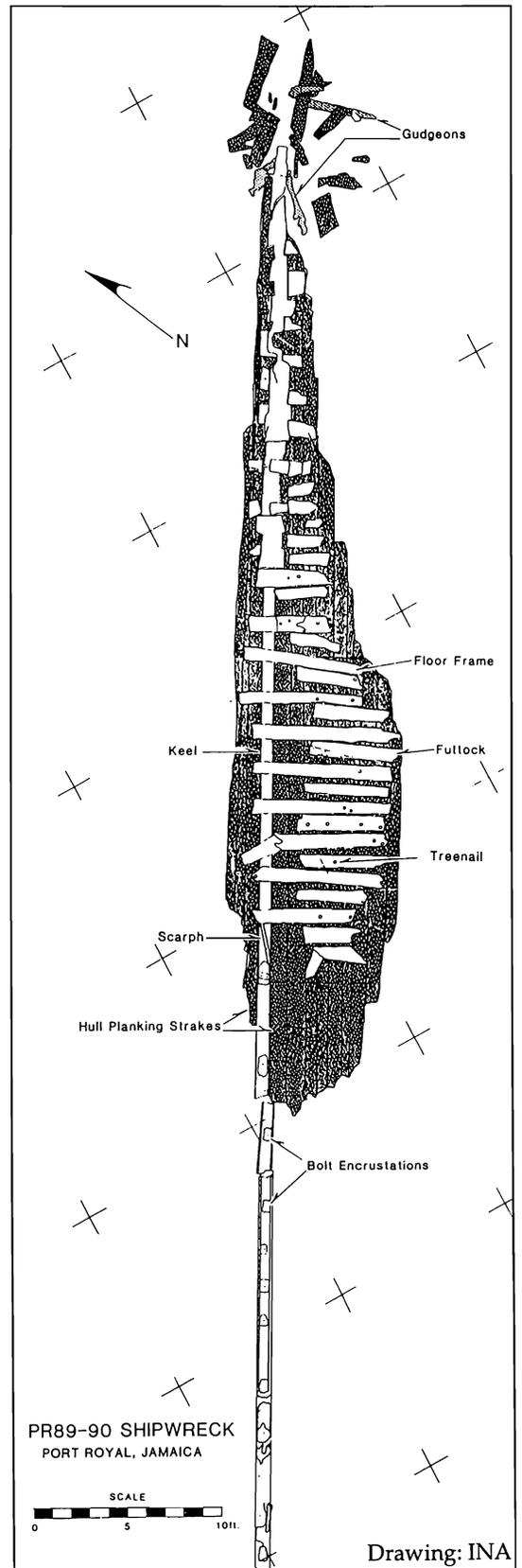
Smith, Roger C. "The Maritime Heritage of the Cayman Islands: Contributions in Nautical Archaeology" (1981). Results of a two-season INA survey and archival research (see *INA Newsletter* 12.3, 8).

Specific Vessels

Amer, Christopher. "Construction of the Brown Bay Vessel" (1986). In 1985, Amer conducted a post-excavation examination of an early nineteenth-century British naval vessel at Browns Bay on the St. Lawrence River, Canada. The history and development of the vessel type, the 54-foot-long hull, and artifactual material were all investigated to identify the hull and determine the reasons for its loss in Browns Bay. A visual reconstruction was possible, establishing two perspective views of the hull using wreck plans and hull lines. Extensive modifications to the hull were discovered, giving indications of the vessel's long and productive career. Most likely constructed as one of His Majesty's naval boats around 1812, it was abandoned after a possible career as a commercial cargo carrier. This only known example of a Royal Navy flat-bottomed boat of this period is significant and unique.

Clifford, Sheila. "An Analysis of the Port Royal Shipwreck and its Role in the Maritime History of Seventeenth-Century Port Royal, Jamaica" (1993). During the 1989 and 1990 seasons of Texas A&M University's underwater archaeological field school at Port Royal, Jamaica, a shipwreck was excavated as it lay amidst the submerged remains of a seventeenth-century building. Several noteworthy construction features were evident on the vessel. While the shipwreck cannot be positively identified, the excavation and recording of the wreck have nonetheless contributed information to the extremely small body of knowledge available concerning seventeenth-century ship construction. After careful analysis, Clifford gives a strong argument for the identity of the vessel as H.M.S. *Swan*, which was undergoing careening at the time of the disastrous 1692 earthquake.

Crisman, Kevin. "The *Eagle*: An American Brig on Lake Champlain During the War of 1812" (1984). An 1814 U.S. Navy brig built in 19 days as the final addition to the fleet that defeated the British at Plattsburgh Bay (see *INA Newsletter* 12.3, 9).



Plan of the Port Royal shipwreck, possibly H.M.S. *Swan*.

Fitzgerald, Michael. "A Roman Wreck at Caesarea Maritime, Israel. A Comparative Study of its Hull and Equipment" (1995). Dissertation (see pages 4–5 of this issue). The hull remains and equipment of a heavy Roman merchant ship are described and illustrated, with particular attention given to its construction. In addition to chapters describing each detail of the ship in its comparative context, the final chapters are devoted to the reconstruction, dating, and analysis of the ship. The comparative studies reveal that the ship in one of the most heavily-built Roman merchant hulls yet documented. Fitzgerald concludes that ancient approaches to the construction of large ships differed fundamentally from approaches common to the building of small ships. The knowledge accumulated through a long history of building big ships contributed to the evolution in ship construction that resulted in the development of "frame-first" techniques.

Haldane, Cheryl W. "The Dashur Boats" (1984). Hulls of six boats buried beside the brick pyramid of Sesostri III at Dashur, Egypt (see *INA Newsletter* 12.3, 8).

Hall, Jerome. "A Seventeenth-Century Northern European Merchant Shipwreck in Monte Christi Bay, Dominican Republic" (1996). Dissertation (see page 7 of this issue). This is a detailed examination of the results of the author's excavation of "The Pipe Wreck," a vessel whose cargo of several styles of tobacco smoking pipes illustrate the processes that brought European culture to the New World.

Hundley, Paul. "The Construction of the Griffon Cove Wreck" (1980). Mid-1800s shipwreck in Lake Huron near Tobermory, Ontario (see *INA Newsletter* 12.3, 8).

Lang, Shelley Ruby. "The *Mittie Stephens*: A Sidewheel Steamboat on the Inland Rivers, 1863-1869" (1986). Over sixty persons lost their lives when this first-class packet enroute from New Orleans to Jefferson, Texas, caught fire near the state line in Caddo Lake. The disaster has become a major feature of folklore in this region of northwest Louisiana and east Texas ("The Mint Tulip Ice Cream Emporium in Jefferson offers the *Mittie Stephens* float—it goes down fast!"). This thesis collects the known information about

the *Mittie Stephens* and its last voyage, and describes a lake survey that possibly located the last remains of the ship. Lang suggests that enough of the hull, machinery, and personal stores may still remain to justify the time and expense of a definitive search and excavation.

Leshikar, Margaret "Peggy." "The 1794 Wreck of the *Ten Sail*, Cayman Islands, British West Indies: A Historical Study and Archaeological Survey" (1993). Dissertation (see page 9 of this issue). Dr. Leshikar brings together documentary research, oral history, and archaeological survey in this study of the wreck, due to a navigational error, of a British naval frigate and nine merchant ships on the windward reef of Grand Cayman Island. The study traces the history of H.M.S. *Convert* from its construction as the French frigate *l'Inconstante*, through its capture near Haiti by the Royal Navy, to its final voyage escorting a convoy of fifty-eight ships bound from Jamaica (fifty-five to Britain and three to America) during the French Revolutionary Wars. Dr. Leshikar follows the story down to the folktales circulating among the Caymanians and an INA survey that located three sites associated with the wreck.

Lloyd, Manuela F. "A Byzantine Shipwreck at Iskandil Burnu, Turkey: Preliminary Report" (1984). Describes findings from the exhaustive 1982–84 survey of a late sixth- or early seventh-century shipwreck (see *INA Newsletter* 12.3, 4–5, 8).

Neyland, Robert. "The Lyons Creek Boat Remains" (1990). The Lyons Creek boat was found in a tributary of Maryland's Patuxent River. Because the vessel was found by a dredging operation, the artifacts recovered with it (dated 1680–1750) have lost their provenience and the wreck may be either newer or older than this interval. The fragments of the boat reveal a boatbuilding heritage descended from the North European shell-based form of construction, with the planking as the primary assembly. There seem to be close parallels to late-medieval Scandinavian shipbuilding. The boat has riveted overlapping thin oak strakes in the traditional clinker-built form. Such construction allowed the builder to erect the hull by eye before setting the unconnected frames (which were not connected into a rigid skeleton). This allowed considerable resilience.

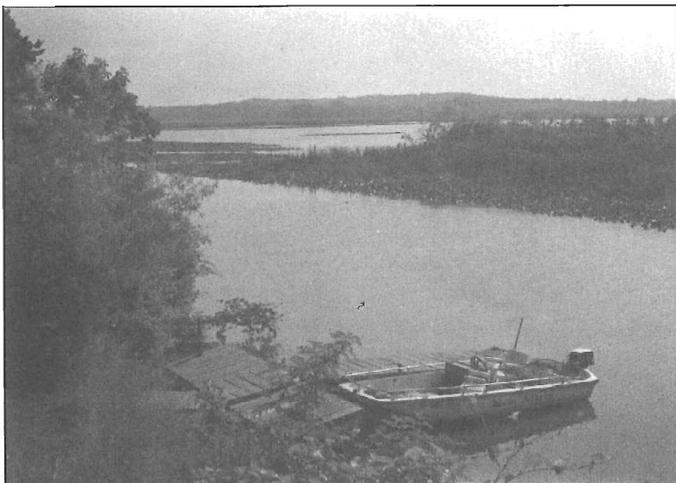
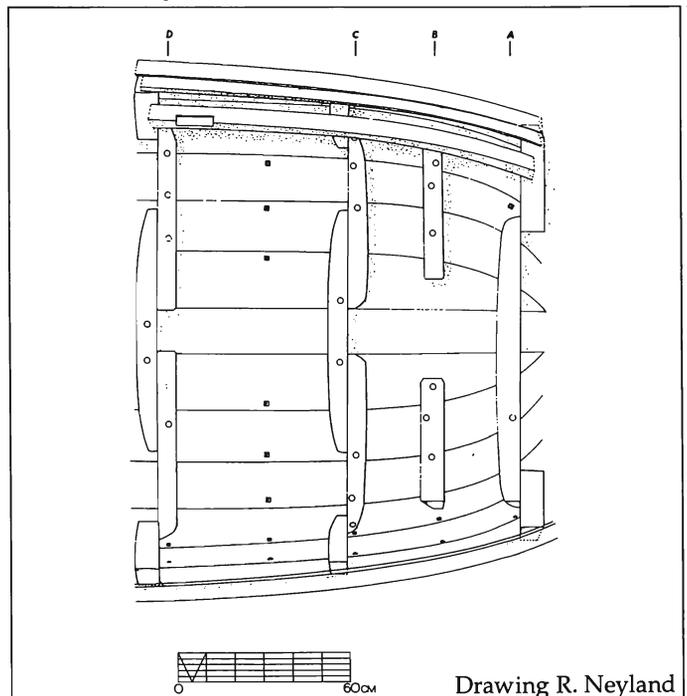


Photo: R. Neyland

Above: The Lyons Creek site with the Patuxent River in the background.

Right: A reconstructed view of the Lyons Creek boat, as seen from above.



Pedersen, Ralph K. "Waterschip NZ42i: A Late Medieval Fishing Vessel from Flevoland, the Netherlands" (1991). The *waterschip* was a distinctive form of Netherlands fishing vessel found, with very few apparent changes, from the Middle Ages down to our own century. As an unglamorous working boat, it has received very little study. The subject of this thesis is one of a number of *waterschepen* that have been discovered in the IJsselmeer polders that formerly lay beneath the Zuiderzee. NZ42i is distinctive because it is the only *waterschip* of clinker-built construction to have received detailed study. This type is older than the carvel-built boats, which are more numerous and better known. Pedersen studies NZ42i in great detail, particularly comparing it with *waterschip* W10, a carvel-built vessel of similar date. He concludes that the *waterschip* falls within a broader Celtic shipbuilding tradition. Archival evidence confirms that similar small craft were common in Maryland waters.

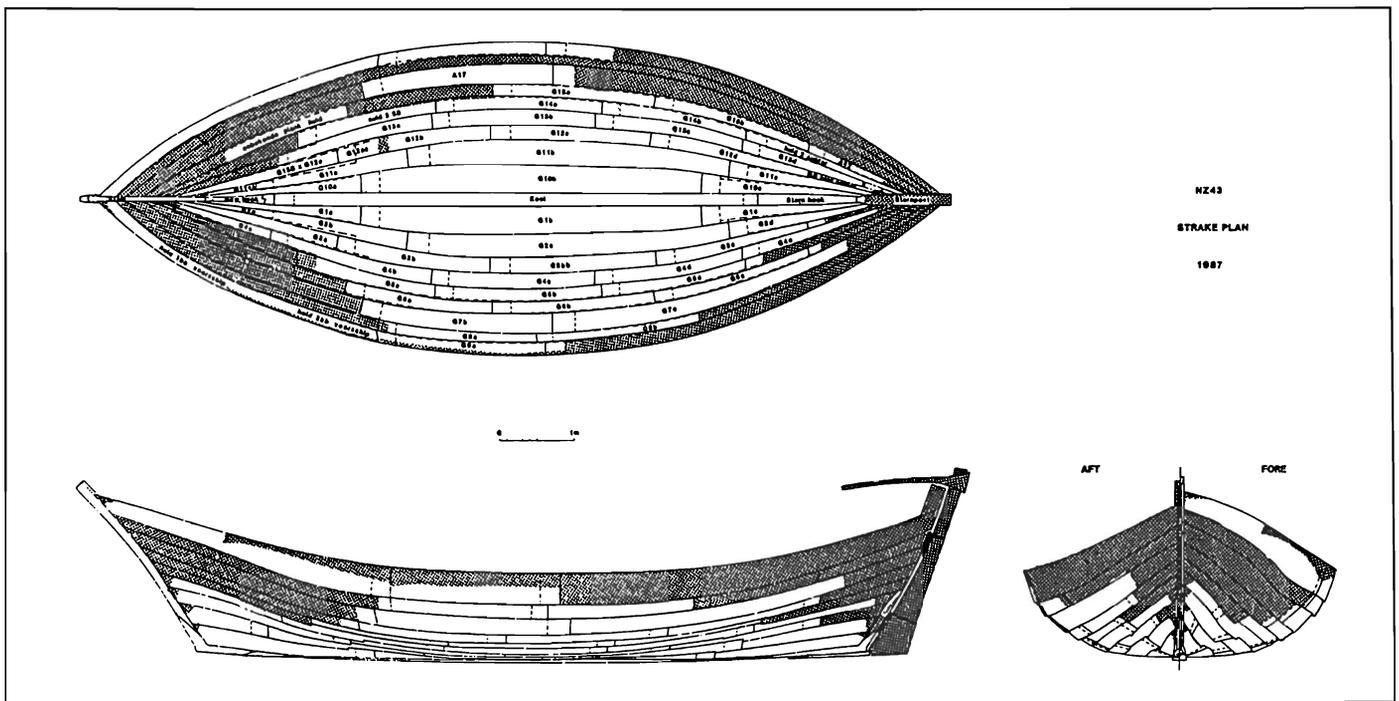
Pulak, Cemaljetin M. "Late Bronze Age Shipwreck at Ulu Burun: Preliminary Analysis (1984-1985 Excavation Campaigns)" (1987). The wealth of objects from the Ulu Burun site, mostly chiseled from rock-hard concretion, have required years of analysis. This thesis by the excavation Director describes the artifacts found in the first two seasons. It was already apparent that the immensely valuable cargo was headed from the east (the Levant or Cyprus) toward the Mycenaean west. Finds included copper and tin ingots in the shape of ox-hides and buns, glass ingots, ivory, resin, and jewelry. Among these items was an Egyptian scarab that already allowed dating the shipwreck to the years immediately after the Amarna period but still within the 18th Dynasty (see *INA Quarterly* 23.1, 12, for later developments concerning the chronology of the Ulu Burun wreck). There were also tools, weapons, equipment, and personal items. Eight stone anchors were found, as well as the hull itself. There was already evidence

of the presence of at least one Mycenaean aboard, but the origin of the ship itself remained unclear at that early stage of research.

Riess, Warren C. "The History of, and Search for, the Seventeenth Century Bristol Merchantman *Angel Gabriel*" (1980). Wrecked in 1635 near Pemaquid, Maine, while carrying settlers and supplies (see *INA Newsletter* 12.3, 9).

Rosloff, Jay P. "The Water Street Ship: Preliminary Analysis of an Eighteenth-Century Merchant Ship's Bow" (1986). This 100-foot-long merchant ship had been installed as pier cribbing along Manhattan Island's East River in the mid-eighteenth century. In 1982, the substantially intact ship was uncovered during an archaeological survey prior to construction at 175 Water Street. The excavators salvaged approximately the first 8 feet of the bow and associated structures. The recovered timbers show both the specifics of constructing a bow and the major structural features of the vessel as a whole. This research cast new light on the vessels that met the requirements for transatlantic transport during the American colonial era.

van De Moortel, Aleydis. "A Cog-Like Vessel from the Netherlands" (1987). A small, well-preserved shipwreck in lot NZ43, near the southern end of the reclaimed Zuiderzee polders, appears to be of a small cargo carrier with many of the characteristics of a cog, the leading seagoing type in late-medieval Northern Europe. The hull was very well built and has been remarkably well preserved. The wreck demonstrates features previously known only from 17th-century Dutch sources. In the 13th and 14th centuries, vessels like this were indispensable for distributing goods to the smaller ports between England and the Baltic. This thesis provides an in-depth analysis of the construction features, hull design, and probable sailing qualities of this cog-like vessel. Since this small craft was so carefully planned and built, we may assume this was also true of the large cogs that carried valuable cargoes in far more dangerous waters.



Strake plan of the reconstructed vessel NZ43, 1987. Shaded areas represent substituted parts.

Drawing: A. van De Moortel

Ship Construction and Equipment

Adams, Robert. "Construction and Qualitative Analysis of a Sewn Boat of the Western Indian Ocean" (1985). Pre-fifteenth century sewn boats along the East African coast (see *INA Newsletter* 12.3, 10).

Charlton, Bill. "Rope and the Art of Knot-Tying in the Seafaring of the Ancient Eastern Mediterranean" (1996). One of mankind's earliest tools must surely have been fibers woven into cords or ropes and tied together with knots. When people first went out onto the water on anything more sophisticated than a simple paddle-driven dugout canoe, they needed the assistance of some type of cordage. A line tied around a stone as an anchor, a line to retrieve a fishing spear, and a line to moor the craft on the beach are all examples of an ancient need. As time progressed, more complex needs led to lines of many different types and sizes. In ancient times, as today, no waterborne vessel could function without rope. Charlton reviews all aspects of rope and knot-tying. He uses the archaeological remains from shipwrecks, and depictions of seagoing vessels from the ancient eastern Mediterranean in art and literary sources, to provide insight into an important but little-known subject.

Franklin, Carol. "Caulking Techniques in Northern and Central European Ships and Boats: 1500 B.C.–A.D. 1940" (1985). A regional survey of waterproofing methods spanning 3500 years (see *INA Newsletter* 12.3, 10).

Geannette, Mark Alan. "Mast Step and Keelson: The Early Development of Shipbuilding Technology" (1983). Traces the merger of these framework members; based on shipwrecks dating from the sixth century BCE to the eleventh century CE (see *INA Newsletter* 12.3, 9).

Goelet, Michael. "The Careening and Bottom Maintenance of Wooden Sailing Vessels" (1986). Before the widespread adoption of drydocks, the only way to perform bottom maintenance on a ship was to careen it (lay it on one side in shallow water or a tidal beach). Because this was so commonplace, nobody thought to record how it was done. Now that the technique has vanished, it is necessary to gather the information in scraps from many sources. This study collects the available data and describes the procedures required to careen large sailing vessels,

emphasizing northern European and North American vessels between 1750 and 1850.

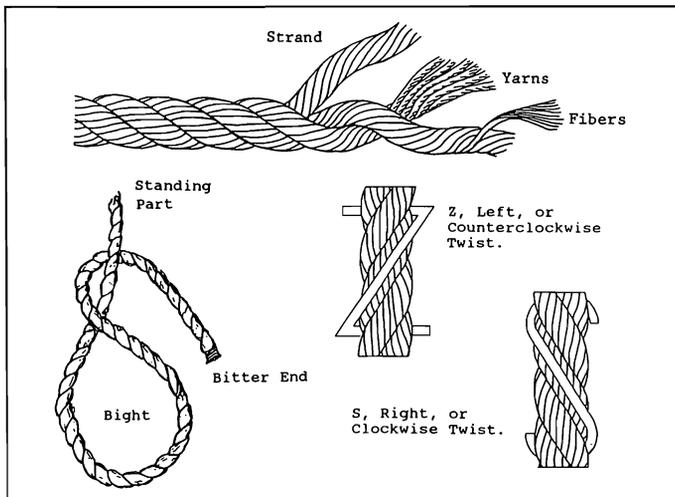
Haldane, Cheryl W. "Ancient Egyptian Hull Construction" (1993). Dissertation (see page 6 of this issue). The dry climate of Egypt has preserved a great many representations and models of ships, as well as about 20 actual hulls. Dr. Haldane studies both the continuity and evolution of hull construction in Egypt, showing how many methods evolved in the pre-dynastic period over 4000 years ago continued in use right down to the present century. The shallow craft with planking joined by edge joinery and lashings were so well adapted to Nile travel that the general design survived both the transition from stone to metal tools and the later transition to nail joinery. This is a definitive study of ancient Egyptian watercraft.

Haldane, David D. "The Wooden Anchor" (1984). Analysis and synthesis of existing information about the wooden anchor that developed toward the end of the seventh century BCE (see *INA Newsletter* 12.3, 67, 9).

Halpern, Michael D. "The Origins of the Carolinian Sideral Compass" (1985). Navigation patterns of peoples in the Indo-Pacific region (see *INA Newsletter* 12.3, 10).

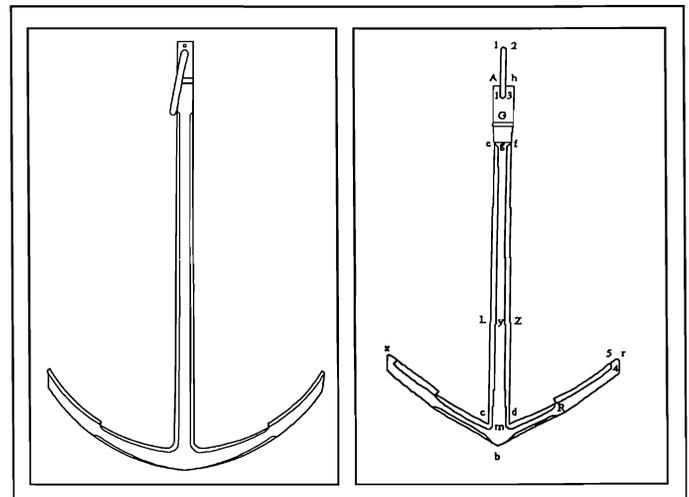
Hocker, Fred. "The Development of a Bottom-Based Shipbuilding Tradition in Northwestern Europe and the New World" (1991). Dissertation (see page 8 of this issue). Dr. Hocker argues for the existence of a bottom-based tradition for the construction of boats and ships, distinct from the long-recognized shell-based and skeleton-based traditions. Craft built in this tradition have a flat bottom laid down with temporary fastenings. The bottom is then permanently fastened to heavy frames, to which the side planking is finally attached. The dissertation traces this tradition from the time of Julius Caesar down to present-day Europe and America.

Jobling, Harold J. (Jim). "The History and Development of the English 'Admiralty' Anchor, ca. 1500-1860" (1993). This thesis examines one of the symbols of the sea that is often overlooked by landlubbers and taken for granted by mariners. Jobling is the first to research the English Admiralty pattern anchor for the period beginning in the 16th century and continuing until



Drawings: W. H. Charlton

Rope Terminology.



Drawings: H. J. Jobling

Left: a French anchor (after Reaumur); Right: an English anchor (after Sutherland), both from the eighteenth century.

the mid-nineteenth century (prior to this period, the basic design of the anchor had been fully developed; after 1850, the increased knowledge of iron technology produced radical changes in anchor design). To enable other researchers to identify an anchor's heritage, Jobling examines the small changes that the anchor underwent. By means of contemporary documents, treatises on shipbuilding, and archaeological records, the anchor's components are fully described, relevant terminology explained, and the number, weight, and size of anchors for various sizes of vessels listed chronologically.

Lamb, William R. "The Provenance of the Stone Ballast from the Molasses Reef Wreck" (1988). Ballast from an early sixteenth century shipwreck in the Turks and Caicos Islands, British West Indies, was analyzed for evidence of its origin and voyage history. The wreck was excavated by INA in 1981-86, and the ballast pile was systematically sampled. Nearly 1200 stones were analyzed with petrography, paleontology, geochemistry, electron microscopy, and geochronology to identify seven major rock groups. Lisbon, Portugal, is believed to be the source for several of the lithologies. Other types (including stones likely from the Canary Islands and from the vicinity of Bristol) could have been picked up by the ship on a prior voyage, or come from ballast that had been offloaded in Lisbon by other ships. The data from the ballast study enabled the excavators of the wreck to examine the rest of the evidence in the light of a possible Portuguese origin for the voyage that ended on Molasses Reef. Lamb's thesis shows the potential for future ballast research.

Matthews, Sheila D. "The Rig of the Eleventh-Century Ship at Serçe Limani, Turkey" (1983). Concludes that the ship used a double-masted lanteen rig (see *INA Newsletter* 12.3, 9).

Monroe, Christopher. "New Kingdom Boat-Building: Interpretations of Existing Evidence" (1990). This study is a summary and analysis of the information gathered over the past century regarding the construction of ships and large, secular craft during the Egyptian New Kingdom period (ca. 1570-1070 BCE). Comparative material from the Late Bronze Age wreck at Uluburun is used to illuminate the data from ancient texts, art, and models. It is concluded that a class of state-employed men, women, and children near Memphis were responsible for building watercraft within a highly organized system. These workers fell somewhere near the bottom of the socio-economic hierarchy. The workplace and technology that had been evolving for almost a millennium underwent changes in the New Kingdom period (including the adoption of the keel), probably as the result of influence from Canaan, the Aegean, and Cyprus.

Moore, Charles David. "Salmon Fishing Boats of the North American Pacific Coast in the Era of Oar and Sail" (1993). The last comprehensive study of small craft on the West Coast of North America was published in 1892 (and did not include British Columbia or Alaska). Moore attempts to plug part of the gap with this study of the interaction of two subcultures, the fishermen of the U.S. and Canadian Pacific inshore salmon fishery, and the boatbuilders who supplied them with their most important tool. Salmon were sought with dugouts, sampans, feluccas, small double-enders, and various flat-bottom craft. Chinese and Italian influences predominated in the early days, with many more ethnic influences moving in over the years. Unfortunately, there is very little historical information available on these craft. Moore suggests that the computer enhancement of old photographs and



Photo: INA

A diver excavating the Molasses Reef Wreck.

(particularly) archaeological exploration of the northwestern estuaries provide the best hope of preserving information about regional small craft.

Mott, Lawrence V. "The Development of the Rudder, A.D. 100-1600: A Technological Tale" (1991). Mr. Mott developed his thesis into a book published by the Texas A&M University Press (see Review on page 31 of this issue). Until the thirteenth century, the primary instrument used to control ships was the quarter-rudder system, mounted on the sides toward the stern. The Mediterranean form of quarter rudder was an inherently simple, adaptable device. The basic system was flexible enough to evolve; medieval rudders were far more efficient than the traditional Greco-Roman rudder. A different pattern of quarter rudder evolved in northern Europe. This less-flexible design forced northern shipwrights to seek an alternative for steering larger ships. This led them to invent the stern rudder mounted on a pintle-and-gudgeon. The new device did not replace the Mediterranean quarter rudder for centuries, until after a significant change in hull design and the emergence of the full-rigged ship. The evolution of the rudder is thus an interesting case study on the development of technology in general.

Myers, Mark D. "The Evolution of Hull Design in Sixteenth-Century English Ships of War" (1987). The transformation from the bulky ships of the fifteenth century into the sleek men-of-war of the seventeenth enabled England to hold its own against European powers with land armies vastly larger than anything Britain could have put in the field. This thesis studies that transformation with data drawn from comparative studies, historical documentation, and art. By using these sources, Myers demonstrates how designs invented during the reign of Henry VIII, with the aid of Italian shipwrights, evolved into the well-known ship of the line. One key development was the decision to mount the heavy ordinance below the main deck, rather than in towering castles. This led to the long, deep warships of Elizabethan times, designed for their nimble sailing qualities, not sheer strength. The battle with the Armada in 1588 validated this design choice. The English, unlike the Spanish, put the cream of their technology below the waterline.

Neyland, Robert. "Technological Continuity and Change: A Study of Cultural Adaptation in Pram-Class Boatbuilding in the Netherlands" (1994). Dissertation (see page 10 of this issue). Dr. Neyland relates the development of a distinctive class of bottom-based watercraft to the evolution of the history, economy, culture, and geography of the Netherlands. The study places these vessels in their context during a period spanning both the Roman period and the twentieth century of our era. Dr. Neyland argues that nautical archaeologists must be willing to look at these broader associations, rather than focusing on ship technology in isolation.

Oertling, Thomas J. "The History and Development of Ships' Bilge Pumps, 1500-1840" (1984). Because all wooden ships leak, pumps are arguably the most important piece of marine equipment (see *INA Newsletter* 12.3, 9-10). Mr. Oertling developed his thesis into a book published by the Texas A&M University Press (see Review on page 30 of this issue).

Olsen, Carol A. "Nineteenth and Twentieth Century Figureheads from the Mystic Seaport Museum Collection" (1984). A general discussion of 5000 years of bow decorations, with special emphasis on twenty figureheads from Mystic (see *INA Newsletter* 12.3, 10).

Pridemore, Matthew. "The Form, Function, and Interrelationships of Naval Rams: A Study of Naval Rams From Antiquity" (1996). The discovery of several naval rams from the Mediterranean has allowed scholars to study one of the most common naval weapons of the ancient world. Five rams have been identified, but Pridemore regards only two of these as functional weapons: the Bremerhaven and Athlit rams. Both show the features of primary waterline rams, he argues. The other three are questionable in this regard on constructional grounds. The Fitzwilliam ram is likely a *proembolion*, a secondary ram used to damage an enemy ship's outrigger and limit primary ram penetration. The Canellopoulos and Turin rams are most likely just decorative bow projections. All five of the rams are most likely from the Hellenistic period. Pridemore calls for further research, as well as for efforts to locate further examples on the sites of ancient naval battles.

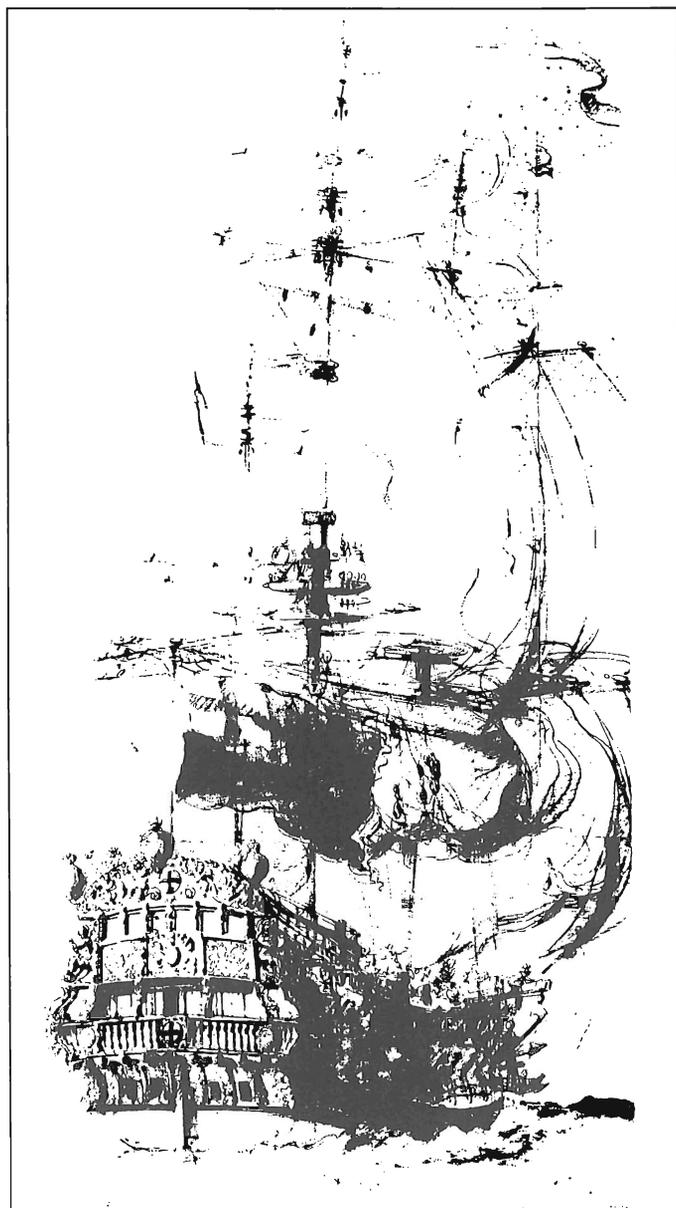
Renner, Mary Ann. "Eighteenth-Century Merchant Ship Interiors" (1987). Despite the importance of merchant shipping in the 18th century, little information has been available concerning their interior furnishings and fittings. Ironically, the very commonness of the vessels explains the lack of contemporary accounts; why document a familiar everyday commodity? This thesis combines the previously-available information with data from the nine shipwrecks discovered by the Yorktown Shipwreck Archaeological Project (see *INA Quarterly* 23.1, 24). The best-preserved wreck, 44YO88 [later identified as H.M.S. *Betsy*], provided particularly rich information about the stylish and well-made appointments of the officer's quarters near the stern and the comparative lack of artifacts from the crew further forward. The Yorktown data allows a very vivid picture of the interior of a relatively small eighteenth-century collier.

Rogers, Edward. "An Analysis of Tomb Reliefs Depicting Boat-Construction From the Old Kingdom Period in Egypt" (1996). This is an examination of the 20 known reliefs and relief fragments from the Old Kingdom private tombs that provide insights into the technology and methodology of wooden hull construction. Because each relief is a unique composition, many details are shown at least once. The majority of the reliefs relate to the final stages of construction. The pictures show how hull symmetry was checked with a plumb bob and how adzes were used to smooth the planking; similar tools were still in use in the early twentieth century CE. The process of joining planks with

mortise-and-tenon edge joints is shown with great clarity, as is the way that rope trusses were used to tighten internal traverse lashed joinery. This technology may have suggested the development of the hogging truss used on seagoing ships and cargo vessels.

Simmons, Joe. "The Development of External Sanitation Facilities Aboard Ships of the Fifteenth to Nineteenth Centuries" (1985). The evolution of hygienic accommodations (see *INA Newsletter* 12.3, 10). Mr. Simmons developed his thesis into a book, *Those Vulgar Tubes*, published by the Texas A&M University Press.

Thompson, Bruce. "The Rigging of a 17th-Century Frigate at Mombasa, Kenya" (1988). It is ironic that we should know so little about the shipbuilding techniques of Portugal, which acted as the advance agent of the "Age of Discovery." Almost uniquely, the Mombasa Harbor Wreck allows comparison of the



The rigging of the 17th-century Frigate at Mombasa, Kenya would have closely resembled that of the Mordaunt shown here and as discussed by Thompson. Courtesy of the Maritime Museum, Greenwich.

details of an India-built Portuguese warship with better-known contemporary designs from elsewhere in Europe. Between 1977 and 1982, INA conducted the excavation of *Santo Antonio de Tanná*, which played a key role in the siege of Fort Jesus in the late seventeenth century. Of 6000 artifacts recovered, 237 pertain in some way to the ship's rig. This thesis presents the analysis of these components and proposes reconstructions of possible rigging features. The wooden fittings are well-fashioned from teak and other quality wood, while the textile materials are sparse and poorly made. It seems likely that the major influence by this time on Portuguese designs was contemporary Dutch ships, although the shipwrights in Portuguese India seem to have relied more heavily on "rule of thumb" methods.

Tolson, Hawk. "The Vernacular Watercraft of Isle Royale: A Western Lake Superior Boatbuilding Tradition" (1992). Isle Royale, Michigan, required several types of small watercraft to meet the needs of the local fishing and resort communities. This once-large fleet has now been reduced to a few scattered remnants by recent historical circumstance. The abandoned hulls on

and around the archipelago preserve the only record of the design and building process operating in the region from the 1880s to the 1960s. This thesis collects the data available through the investigation of these derelicts, and combines it with oral history interviews with surviving boatbuilders and commercial fishermen. This allows the clarification of many details of the evolution of local watercraft types.

Vinson, Stephen M. "Boats of Egypt Before the Old Kingdom" (1987). This study traces the origin and early development of planked boats in Predynastic and Early Dynastic Egypt. There is a considerable body of material available for study of these periods, including representational art, tools and woodworking, boat burials, and surviving fragments. Vinson argues that the development of nautical technology in the Nile Valley was indigenous and independent of influence from Mesopotamia, Minoan Crete, or elsewhere. The techniques of shell-based boatbuilding and mortise-and-tenon joinery used in later Egypt, and even in Greece and Rome, are found to be directly dependent on methods perfected in prehistoric Egypt.

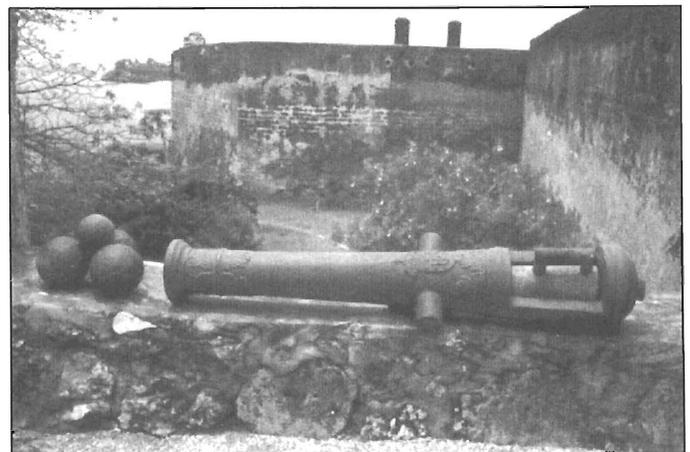
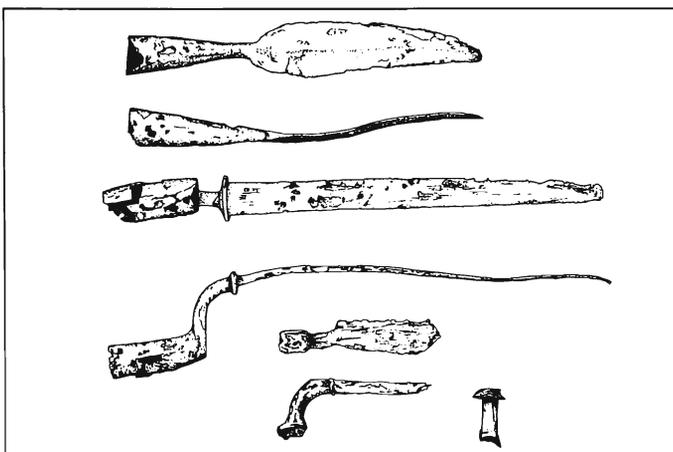
Artifacts

Brenni, Gianmarco. "The *Dolia* and the Sea-Borne Commerce of Imperial Rome" (1985). Study of huge ceramic vessels used from the 1st century BCE to the 5th century CE (see *INA Newsletter* 12.3, 11).

Carter, Brinnen. "Armament Remains From His Majesty's Sloop *Boscawen*" (1995). Carter's thesis describes and analyzes the armament remains found in and around the hull of the 1759 Lake Champlain warship *Boscawen* during its excavation in 1984 and 1985. Weaponry recovered at that time included small arms parts, ammunition, pole arms, and artillery munitions. The distribution of the armaments indicated that muskets, other personal weapons, and artillery munitions were loaded into the center of the hold, while ammunition for small arms was loaded in the bow and stern. Carter describes these finds and suggests that a re-examination of armament remains from the Seven Years War would improve our understanding of the period.

Cassavoy, Kenneth. "The Gaming Pieces from the Glass Wreck at Serçe Limani, Turkey" (1985). A study of Islamic games, including chess, backgammon, and dicing (see *INA Newsletter* 12.3, 11).

Darroch, Alison. "The Visionary Shadow: A Description and Analysis of the Armaments Aboard the *Santo Antonio de Tanna*" (1986). This thesis concerns the armament collection from a shipwreck in the Old Harbor of Mombasa on the Kenyan coast. The wreck is that of the *Santo Antonio de Tanná*, a Portuguese vessel that was sunk in 1697 during an attempt to relieve Fort Jesus. The history of the siege is given first to set the shipwreck in its historical context. Then, a brief description of the excavation is followed by a catalog of the armaments and related artifacts found during excavation. Research into the various categories of armaments made it clear that many of the artifacts



Armament remains have been popular topics in a number of theses. On the left are some of the weapons from His Majesty's Sloop *Boscawen* while on the right are shown some of those from the *Santo Antonio de Tanná*.

Photos: INA

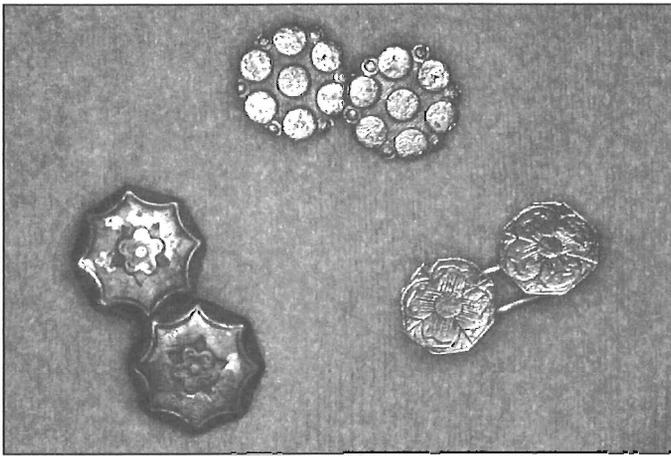


Photo: INA

Buttons were among the 1,345 items relating to the crew's clothing, diet, and recreation found on H.M.S. *Boscawen*.

have no parallels in museums or other collections. Only five guns were found on the site. Because of this, the projectiles, cartridge molds, and powder ladle have been analyzed in order to predict what types of ordnance the *Santo Antonio de Tanná* was probably carrying.

Erwin, Gail. "Personal possessions from the H.M.S. *Boscawen*: Life on Board a Mid-Eighteenth-Century Warship During the French and Indian War" (1994). In addition to serving as a warship, *Boscawen* was used to transport soldiers and supplies to British fortifications along Lake Champlain. In 1763, it was taken out of service and eventually sank into the mud below Fort Ticonderoga. Between 1983 and 1985, the excavation of *Boscawen* was carried out as a multidisciplinary study of naval architecture, maritime history, shipboard life, and artifact conservation. The assemblage reported here consists of 1,345 items relating to the crew's clothing, diet, and recreation. The study of these artifacts has contributed to our knowledge of shipboard life on British Army warships during the French and Indian War, indicating the terms of interaction between British and Provincial forces, and reflecting the relationship between the armies and navy.

Franklin, Marianne. "Wrought Iron Hand Tools in Port Royal, Jamaica: A Study Based upon a Collection of the Tools Recovered from Archaeological Excavations and on Tools Listed in the Probate Inventories of Colonial Port Royal, c. 1692" (1992). 181 pages. This study is based upon a collection of wrought iron hand tools recovered from five archaeological excavations of Port Royal, Jamaica, between 1966 and 1990. Over 100 tools have been recovered so far from the archaeological excavations of Port Royal, ranging from the finely shaped pincher of the shoemaker to the most crudely fashioned chisel. This study combines the analysis of the archaeological record and probate inventories to answer questions about the variety of tools available and in common use by the seventeenth century craftsman in the Caribbean. It is hoped that this work will provide a significant data base for future comparative studies on tools of the late seventeenth century.

Garigen, Lisa. "Description and Analysis of Flintlock Pistols Recovered from a Seventeenth-Century Shipwreck on Pedro Bank, Jamaica" (1991). Garigen presents a complete catalog of the pistols and pistol fragments recovered from the Spanish fleet

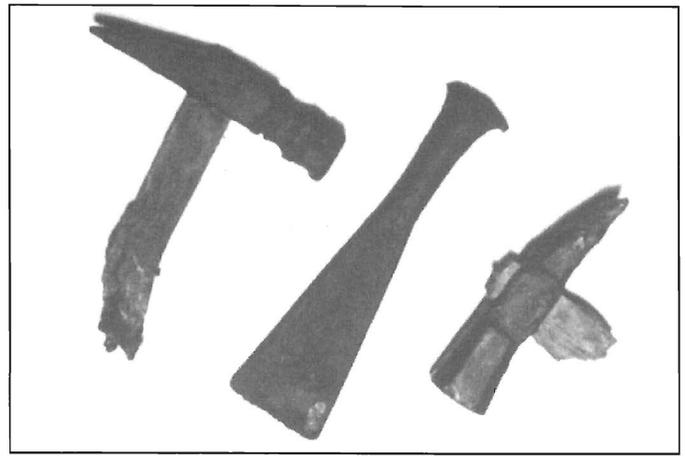


Photo: INA

Over one hundred hand tools have been recovered from Port Royal, including these.

ship that sank in 1691 on Pedro Bank, Jamaica. A brief history of the Spanish fleets and the development of flintlock pistols are given. The archaeological excavation at Pedro Bank and the later conservation treatments and their effects are discussed. Garigen shows that the pistols were probably not of Spanish origin as first assumed, but more likely English or Dutch. The pistols were probably not being used for defense of the ship, since they were stored in boxes of cacao beans. The number of pistols found (54 recovered and others left on site) indicates they were part of the cargo.

Garver, Elizabeth. "Byzantine Amphoras of the Ninth through Thirteenth Centuries in the Bodrum Museum of Underwater Archaeology" (1993). A total of fifty-nine Byzantine amphoras of nine classes, dating from the 9th to 13th centuries, were examined, cataloged and discussed. The preponderance of parallels in the Black Sea region to those in the Mediterranean world was striking. This is undoubtedly due to the greater amount of archaeological research covering this period in that region. However, it could be also be the result of differing trading patterns. Standardization of shape and capacity are discussed along with reuse and transfer of ownership. Garver also investigates economic issues that could influence a potter's production strategies.

Gotelipe-Miller, Shirley. "Pewter and Pewterers from Port Royal, Jamaica: Flatware before 1692" (1990). The Port Royal Pewter Collection is not only the world's largest assemblage of late seventeenth-century pewterware. It also includes the earliest examples of English colonial pewter, and the most extensive hoard of pewter artifacts recovered from a single archaeological setting. Gotelipe-Miller sets out to cover one section of the greater picture, the flatware, and provide a basis for future study. Four major areas of research are explored. Firstly, how the pewter got to Jamaica is considered and what trade implications may result. Secondly, the study used pewter artifacts as a means to understand the city's submerged ruins by examining archaeological associations and ownership monograms. Thirdly, social and economic implications were explored by the use of archival documents. Finally, the flatware was fully documented, thereby establishing archaeological guidelines for future recording of pewter.

Grant, David. "Tools from the French and Indian War Sloop *Boscawen*" (1996). Archaeological excavation of the hull in 1984–5 revealed a surprisingly large number of artifacts, with tools representing a small but diverse segment of the total assemblage. Unexpectedly, few of the tools from *Boscawen* are comparable to those used by ship's carpenters and shipwrights, and that are commonly associated with shipwrecks. Instead, the tools represent types commonly used by eighteenth-century armies for fortification, siegework, and fatigue duties. These may have been used by the crew or the troops the ship transported, but most were probably some sort of cargo, either tools for use by the British Army, or scrap iron collected from British and French sites during or immediately after the war.

Haddan, Lester James. "Ceramics from the American Steamboat *Phoenix* (1815–19) and their Role in Understanding Shipboard Life" (Anthropology Department 1995). This was a first-class steamer used to ferry passengers between Whitehall, New York, and St. John, Quebec, during the five years from its construction until it was destroyed by fire. The ceramic assemblage from the shipwreck shows that the items used on this early steamboat closely resembled those found in ordinary rural American homes and inns. True luxury items were not found, suggesting that this pioneer in mechanized water travel offered its passengers comforts much like a country inn.

Hailey, Tommy Ike. "The Analysis of 17th-, 18th-, and 19th-Century Ceramics from Port Royal, Jamaica for Lead Release: A Study in Archaeotoxicology" (1994). Anthropology Department dissertation (see page 5 of this issue). Studies of the possibility of lead poisoning in the past have tended to use historical records and skeletal analyses for evidence, and have ignored artifactual analysis. This dissertation attempts to fill that gap by studying the lead-glazed ceramics from Port Royal. Initial tests confirmed the potential for a substantial lead release from these glazes. Further tests on sherds and glazed ceramic tiles allowed the development of a framework for predicting the rate of lead release from any vessel under various conditions.

Heidtke, Kenan. "Jamaican Red Clay Tobacco Pipes" (1992). Locally-made red clay pipes from Jamaica are studied in detail. Pipes from other colonial sites in the New world are also

examined to identify possible parallels. The presence of red clay pipes reflects the interactions between European, African and native American societies that were to shape Colonial society. White European pipes were copied in the local Jamaican red clay, probably by craftsmen of African descent. The various decorations on the pipes are cataloged and used to offer possible explanations of the markings and stylistic attributes of the pipes.

Hirschfeld, Nicolle. "Incised Marks on Late Helladic and Late Minoan III Pottery" (1990). This is a study of the incised signs often found on ceramics produced in the Aegean near the end of the Late Bronze Age. Most of the marked vessels were found on large fineware transport or storage vessels on Cyprus or in the Near East, with another substantial deposit in the Argolid. The marks show many affinities to the Cypro-Minoan characters, but not to Linear B. Both the distribution pattern and the nature of the marks suggests a Cypriot connection. The presence of these jars in the Argolid suggests that the vessels were designated for export to Cyprus while still on the mainland, and marked for that purpose. There appears to be no pattern restricting a particular sign to a certain shape, decorative pattern, region, or context. The marks are thus most likely to be personal marks of the Cypriots handling the merchandise.

Hoyt, Steven D. "An Empirical System for the Identification of Smooth Bore, Cast Iron Cannon" (1986). Any data collected by different researchers inherently differs by some degree. Hoyt tries to establish an objective, quantitative system for gathering, storing, and manipulating information on smooth bore, cast iron cannons. Physical characteristics of cannons are described, and detailed instructions are given for the recording of various attributes for computer correlation and analysis. Data from a small sample of six reliably-dated cannon from a 250-year period is used to analyze the position of the trunnions. Hoyt employs his methods to shed some doubt on the popular hypothesis that the position of the trunnions correlates directly with the age of the gun—the lower the trunnion, the older the gun. Hoyt hopes his thesis provides the foundations for a long-term, quantitative study of cannons from a larger, more statistically reliable sample.

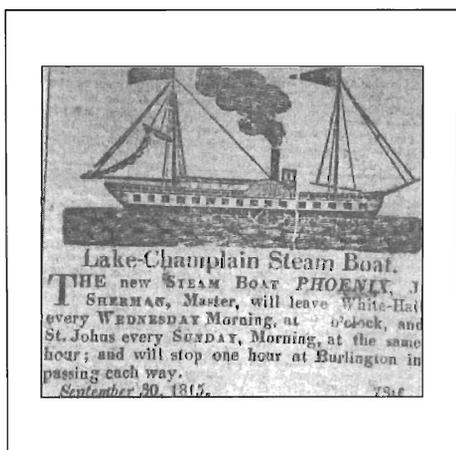


Photo: INA



Photo: INA

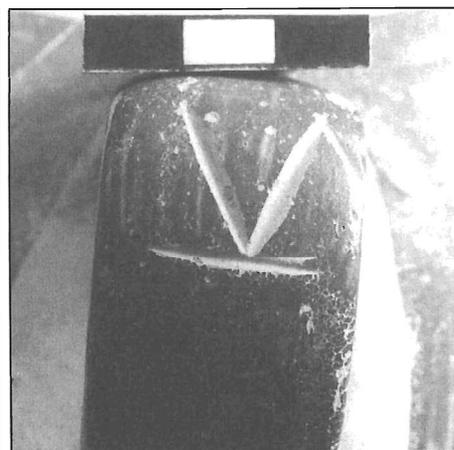
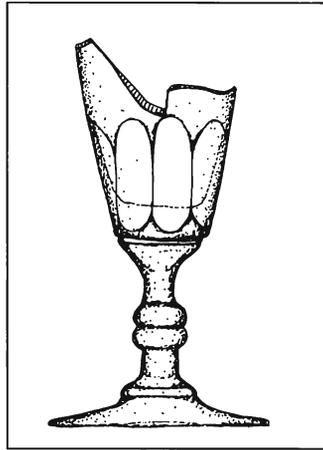
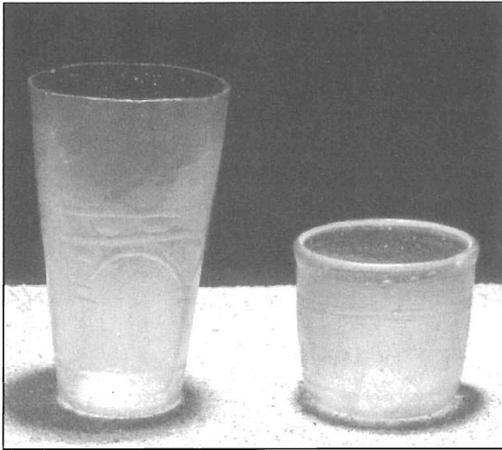


Photo: N. Hirschfeld

The Lake Champlain steamboat Phoenix (left); Ceramics from Port Royal (center); An inscription on a Minoan jar handle from Hala Sultan Tekke (right).



Glass beakers (left) from the eleventh-century Serçe Limani shipwreck; Drinking glass (center) from Port Royal; Nicolle Hirschfeld, Michael Halpern, and Claire Peachy examining amphora contents at Uluburun.

Photos and drawings: INA

James, Stephen R., Jr. "The Analysis of the *Conde de Toluosa* and the *Nuestra Señora de Guadalupe Olive Jar Assemblage*" (1985). Two vessels sunk in 1724 contained 600 intact olive jars, providing new comparative data (see *INA Newsletter* 12.3, 11).

Kitson-MimMack, Joy. "The Glass Beakers of the Eleventh-Century Serçe Limani Shipwreck" (1988). The glass cargo of the Serçe Limani wreck has provided a wealth of knowledge and a greater understanding to scores of scholars worldwide who are interested in Islamic glass of the eleventh century. Kitson-MimMack provides a descriptive catalog of ninety-five of the best-preserved and most significant beaker vessels and pieces. A comparative study of the iconography and style of the engraved decorations, the quality of engraving work, colors, and glass quality are also studied. The Serçe Limani beakers can firmly dated to the latter part of the third decade of the eleventh century CE, making this thesis a valuable contribution to Islamic glass studies.

Lyon, Jerry D. "The Pottery from a Fifth Century B.C. Shipwreck at Ma'agan Michael, Israel" (1993). The ceramics from this shipwreck excavated off the coast of Israel between 1988 and 1990 can be dated to approximately 425 to 400 BCE. Transport amphoras are found only in small numbers, so it appears that most of the pottery was used by the crew, rather than forming a part of the cargo. However, it is possible that most of the cargo was salvaged at the time the ship wrecked near the beach. A number of ceramic vessels are common types known from the Persian period strata of the Levantine coast, although many have good Cypriot parallels. Attic and East Greek wares are represented by few examples. The pottery assemblage suggests that the ship was bound from the southern coast of Cyprus to one (or more) of the Phoenician settlements along the eastern coast of the Mediterranean.

McClenaghan, Patricia. "Drinking Glasses from Port Royal, Jamaica, circa 1660-1850: A Study of Styles and Usage" (1988). Among the numerous glass artifacts recovered from Port Royal was an extensive collection of items and fragments that can be identified as drinking glasses. Most of these are English, manufactured in the late-seventeenth, eighteenth, and nineteenth centuries. This thesis provides a descriptive catalog of the Port Royal drinking glasses to provide comparative data for scholars in-

involved in similar artifactual research. The fine-quality table glass from the late seventeenth century shows the relative wealth and prosperity of Port Royal during that period. The number of tavern glasses reinforces contemporary accounts that the town was full of punch houses and inns, and agrees with the number of liquor bottles recovered from the city. The glassware finds confirm the declining population after the 1692 earthquake and subsequent hurricanes.

Morden, Margaret E. "The Glass Lamps from the 11th-Century Shipwreck at Serçe Liman, Turkey" (1982). 235 broken glass lamps, probably from the Syro-Palestinian coast or inland to the Caspian Sea (see *INA Newsletter* 12.3, 10).

Peachy, Claire. "Terebinth Resin in Antiquity: Possible Uses in the Late Bronze Age Aegean Region" (1995). The Late Bronze Age wreck at Uluburun yielded the remains of an estimated one metric ton of terebinth resin in about 130 amphoras. This is the largest single deposit of terebinth resin from antiquity ever found, and the first to be found by modern analytic methods. The yellowish, semi-fluid, aromatic resin is the subject of this thesis. *Pistacia* trees have many products in addition to resin, including their fruits, leaves, bark, wood, and galls, all of which have aromatic and astringent properties. Peachy concludes that the Linear B word *ki-ta-no* may refer to any of the products of the terebinth tree. The Late Bronze Age evidence from the Aegean is scanty, but parallels from other regions and later periods allow the tentative conclusion that the resin might have been intended for use in either the perfumed oil industry or as incense.

Pulak, Cemal M. "Analysis of the Weight Assemblages from the Late Bronze Age Shipwrecks at Uluburun and Cape Gelidonya, Turkey" (1996). Dissertation (see page 12 of this issue). The pan-balance weights found in these two shipwrecks are the largest assemblages of such artifacts from any Bronze Age site. Statistical analysis allows Dr. Pulak to conclude that most of the weights were used in connection with a decimally-structured system for measuring mass with a basic unit of approximately 9.3 grams. This system is known to have been used in the Syro-Palestinian area and Cyprus. That suggests that most of the merchants aboard the two Late Bronze Age ships came from that region, rather than from the Aegean, where a binary-structured system with a basic unit of about 61 grams was used.



The cylindrical amphoras from the seventh-century Yassı Ada shipwreck (left) and pewter from Port Royal (right) have both been the subject of several theses.

Photos: INA

Smith, Wayne. "Analysis of the Weight Assemblage of Port Royal, Jamaica" Dissertation (see page 13 of this issue). Dr. Smith describes the scale weights discovered during the excavations of sections of the city that were submerged by an earthquake in 1692. These form one of the largest collections of seventeenth-century weights. The Port Royal weights are placed in the context of the development of the standard British systems for measuring mass (troy and avoirdupois weight), and the evolution of the artifacts used to measure mass. The information gained from the excavated weights is then used to suggest the use of the rooms and buildings where they were found.

Thornton, Diana. "The Probate Inventories of Port Royal, Jamaica" (1992). Archaeology always requires a multi-faceted approach, and that approach is illustrated by this thesis. Historical archaeology is the study of *all* remains, Thornton points out, not just those that come from the ground. The probate inventories of the parish of Port Royal provide much information about the material culture and social history of seventeenth-century Jamaica. Admittedly, they concentrate on the upper classes, ignore liabilities and real estate, and tend to vagueness, but they are often the best information available. When combined with other documentary sources and data from archaeological excavations, the inventories help form a much more complete reconstruction of Caribbean colonial life. This thesis acts as a guide to the Port Royal probate inventories for future researchers.

Turner, Sam. "Saona Artillery: Implication for Inter-Island Trade and Shipboard Armaments in the First Half of the Sixteenth Century" (1994). The island of Saona in the Mona Pas-

sage between Hispaniola and Puerto Rico is the site of at least three sixteenth-century shipwrecks. This thesis studies the guns examined at or excavated from these sites, and places them in the context of Mona Passage navigation in the early sixteenth century, wrought-iron artillery construction, and contemporary artillery tactics. Since the sites appeared to be unsalvaged, these are probably complete artillery collections from lightly-armed vessels with one or two tube guns, four to eight swivel guns, and some additional portable weaponry. Turner concludes that the 1983 examination of these three sites was brief and incomplete, so a future reinvestigation might discover many new facts about commerce in this important part of the early colonial New World.

van Alfen, Peter. "A Restudy of the Cylindrical Amphoras from the Seventh-Century Yassı Ada Shipwreck" (1995). This thesis catalogs 71 of the 822 recorded amphoras from the shipwreck excavated under the direction of George F. Bass in 1961–64, and again in the early 1980s. The author also presents a summary of the amphoras' significant features, following the lead of F.H. van Doorninck, Jr.'s work on the eleventh-century amphoras from Serçe Limanı. The Yassı Ada vessels were apparently not so carefully calibrated to a standard measurement as those at the other site.

Wadley, Cathryn. "Historical Analysis of Pewter Spoons Recovered from the Sunken City of Port Royal, Jamaica" (1985). Presents the basis for a preliminary key for identifying and dating pewter spoons from seventeenth and eighteenth-century sites (see *INA Newsletter* 12.3, 11).

Conservation

Parrent, James M. "The Conservation of Waterlogged Wood Using Sucrose" (1983). Experiments with four techniques

using inexpensive sugar solutions to conserve Port Royal wood remains (see *INA Newsletter* 12.3, 11).

Technical

Darrington, Glenn. "Analysis and Reconstruction of Impermanent Structures of the 17th and 18th Centuries" (1994). Impermanent architecture was a major technology used to construct shelter in the Americas during the seventeenth and eighteenth centuries. Darrington uses Computer Aided Design (CAD) technology to reconstruct three historic buildings (including one from the TAMU/INA excavation of Port Royal). Each of these structures represents a stage in the settlement process which was used by early colonists to survive and succeed in the New World. Earlier methods of recording site data have been compared with more modern methods possible with CAD technology. These new methods have shown that more information can be gathered, manipulated, and displayed than was previously possible. This opens new doors of opportunity for researchers who try and recreate the historic past.

Weinstein, Eri Nattan. "The Recovery and Analysis of Paleoethnobotanical Remains from an Eighteenth Century Shipwreck" (1992). Anthropology Department dissertation (see page 14 of this issue). Due in part to the fact that the collier brig *Betsy*, scuttled during the Battle of Yorktown in October 1781, was excavated inside a cofferdam, it was possible to study the paleo-

ethnobotanical material in an innovative manner. Instead of a small sample, 100% of the fill excavated from the site in 1986–88 (237 cubic meters) was tested. This allowed the recovery of extensive cask fragments, macrofossil remains, and pollen that provided valuable information about the use of the ship during the climactic battle for American independence.

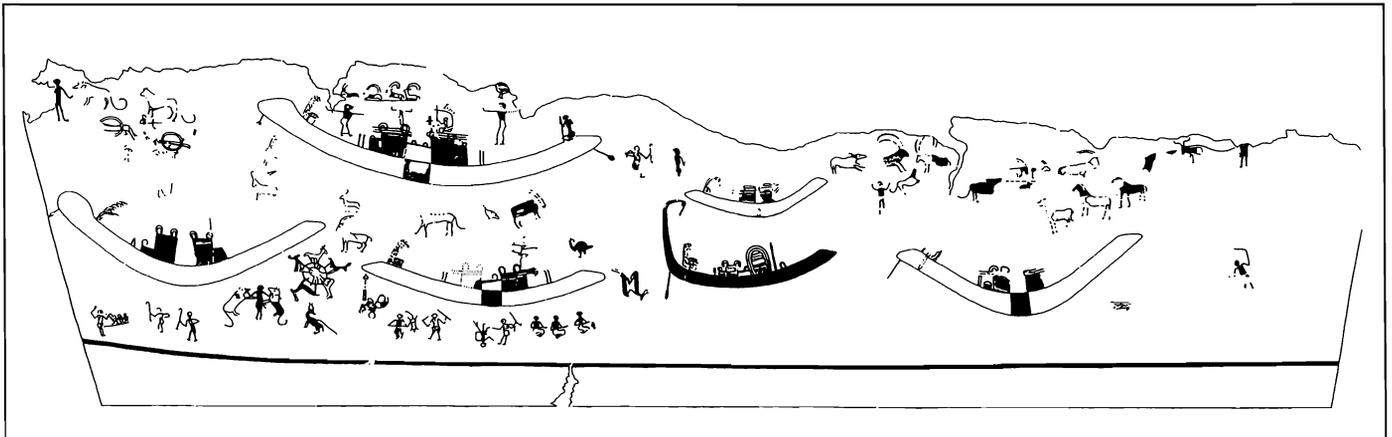
Woodward, Robyn P. "The Charles Cotter Collection: A Study of the Ceramic and Faunal Remains" (1988). This collection consists of Spanish and Arawak material from Sevilla la Nueva, the major port and capitol of the Spanish colony of Jamaica between 1509 and 1534, excavated by Captain Charles Cotter between 1953–1968. During the early Spanish colonial period, Jamaica played an important role in supplying foodstuffs and animals to the early European ventures into Central America. Woodward describes the ceramic and faunal remains associated with each of the three major features excavated by Cotter. This demonstrates the function of each structure. The Sevilla la Nueva remains also illustrate the ways in which the foodways of the early colonists adapted to the conditions of the new environment. Finally, the remains are found to indicate the level of foreign trade to this remote new colony.

Trade

Mark, Samuel E. "A Study of Possible Trade Routes between Egypt and Mesopotamia, ca. 3500-3100 B.C." (1993). It is certain that there was contact between the Mesopotamian cultures and Predynastic Egypt, but there has been little effort to find the route these objects and motifs followed. Mark compares Mesopotamian influences in Egypt with those found in northern Syria and the Gulf region. He concludes that most influences traveled from Mesopotamia inland to northern Syria, then both by sea from the Syrian coast to Egypt and by land through Palestine. There is no evidence that the southern route by sea around Arabia to the Red Sea was in use during this period. The expansion of Mesopotamian influence to the southern Gulf occurred just as Mesopotamian influence on Egypt was coming to an end (see book announcement on page 31).

Smith, Mark. "The Development of Maritime Trade Between India and the West From C. 1000 to C. 120 B.C." (1995). There

has been much attention given by scholars to the trade between India and the Roman world. However, there has been much less study devoted to the roots of this trade in earlier periods. Contacts between India and the West were stimulated by the activities of the Persian Empire, which stretched from Egypt to India. The Persian monarchs, and later Alexander the Great, attempted to integrate their far-flung provinces commercially. Although political unity shattered after Alexander's death, trade between India and the West continued to expand. Merchants in Arabia acted as the middlemen for the ships carried to and fro by the shifting monsoon winds. However, trade was largely one-way. Western markets were eager for many types of Indian goods, but the Indians were only interested in Western gold. The result was a balance-of-payments imbalance, and a drain of European gold to South Asia.



Hierakonpolis mural (after J. E. Quibell and F. W. Green, Hierakonpolis II [London 1989] pl. 75)

Drawing: S. Mark

Miscellaneous

Parrent, James M. "Management of Historic Ship Archaeological Sites in the Caribbean" (1990). Anthropology Department dissertation (see page 11 of this issue). Dr. Parrent provides a detailed description of a major threat to the Caribbean historical and archaeological heritage—the destruction of important sites by treasure hunters. There is an alternative, the dissertation suggests: the Caribbean nations can take control of their own national treasures and enlist the assistance of experts from universities and non-profit organizations to help preserve, study, and display significant archaeological sites and artifacts.

Ray, Lillian. "Venetian Ships and Seafaring up to the Nautical Revolution: A Study Based on Artistic Representations

of Ships and Boats Before ca. 1450" (1992). The Venetian Republic and maritime commerce are completely inextricable subjects for the student of the medieval history and archaeology of the eastern half of the Mediterranean Basin. Venice was the focus for interaction between East and West. There are basically three sources of information on Venetian ships: archaeological remains, written documents, and artistic representations. However, maritime art cannot be utilized as a resource unless it has been adequately cataloged and analyzed. This thesis attempts to perform that service for the medieval art of the Veneto region, allowing access to the Venetian ship and boat representations dating before the second half of the 15th century.

Alphabetical List of Thesis and Dissertation Authors 1978–1996

- Adams, Robert. "Construction and Qualitative Analysis of a Sewn Boat of the Western Indian Ocean" (1985).
- Amer, Christopher. "Construction of the Brown Bay Vessel" (1986).
- Baker, James. "Computers and Nautical Archaeology: Characterization of the C.S.S. *Georgia* Wreck Site" (1982).
- Brenni, Gianmarco. "The *Dolia* and the Sea-Borne Commerce of Imperial Rome" (1985).
- Carter, Brinnen. "Armament Remains From His Majesty's Sloop *Boscawen*" (1995).
- Cassavoy, Kenneth. "The Gaming Pieces from the Glass Wreck at Serçe Limani, Turkey" (1985).
- Charlton, Bill. "Rope and the Art of Knot-Tying in the Seafaring of the Ancient Eastern Mediterranean" (1996).
- Clifford, Sheila. "An Analysis of the Port Royal Shipwreck and its Role in the Maritime History of Seventeenth-Century Port Royal, Jamaica" (1993).
- Cowin, Margaret. "Artifacts Recovered off the Southwestern Turkish Coast by Institute of Nautical Archaeology Shipwreck Surveys in 1973 and 1980" (1986).
- Crisman, Kevin. "The *Eagle*: An American Brig on Lake Champlain During the War of 1812" (1984).
- Darrington, Glenn. "Analysis and Reconstruction of Impermanent Structures of the 17th and 18th Centuries" (1994).
- Darroch, Alison. "The Visionary Shadow: A Description and Analysis of the Armaments Aboard the *Santo Antonio de Tanna*" (1986).
- Erwin, Gail. "Personal possessions from the H.M.S. *Boscawen*: Life on Board a Mid Eighteenth-Century Warship During the French and Indian War" (1994).
- Fitzgerald, Michael. "A Roman Wreck at Caesarea Maritime, Israel. A Comparative Study of its Hull and Equipment" (1995). Dissertation.
- Franklin, Carol. "Caulking Techniques in Northern and Central European Ships and Boats: 1500 B.C.–A.D. 1940" (1985).
- Franklin, Marianne. "Wrought Iron Hand Tools in Port Royal, Jamaica: A Study Based upon a Collection of the Tools Recovered from Archaeological Excavations and on Tools Listed in the Probate Inventories of Colonial Port Royal, c. 1692" (1992).
- Garigen, Lisa. "Description and Analysis of Flintlock Pistols Recovered from a Seventeenth-Century Shipwreck on Pedro Bank, Jamaica" (1991).
- Garver, Elizabeth. "Byzantine Amphoras of the Ninth through Thirteenth Centuries in the Bodrum Museum of Underwater Archaeology" (1993).
- Geannette, Mark Alan. "Mast Step and Keelson: The Early Development of Shipbuilding Technology" (1983).
- Goelet, Michael. "The Careening and Bottom Maintenance of Wooden Sailing Vessels" (1986).
- Gotelipe, Shirley. "Pewter and Pewterers from Port Royal, Jamaica: Flatware before 1692" (1990).
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- Haldane, Cheryl W. "The Dashur Boats" (1984).
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- Heidtke, Kenan. "Jamaican Red Clay Tobacco Pipes" (1992).
- Hirschfeld, Nicole. "Incised Marks on Late Helladic and Late Minoan III Pottery" (1990).
- Hocker, Fred. "The Development of a Bottom-Based Shipbuilding Tradition in Northwestern Europe and the New World" (1991). Dissertation.
- Hoyt, Steven D. "An Empirical System for the Identification of Smooth Bore, Cast Iron Cannon" (1986).
- Hundley, Paul. "The Construction of the Griffon Cove Wreck" (1980).

- Indruszewski, George. "A Comparative Analysis of Early Medieval Shipwrecks From the Southern Shores of the Baltic Sea" (1996).
- Inoue, Takahiko. "A Nautical Archaeological Study of Kublai Khan's Fleets" (1991).
- James, Stephen R., Jr. "The Analysis of the *Conde de Tolosa* and the *Nuestra Senora de Guadalupe* Olive Jar Assemblage" (1985).
- Jobling, Harold J. (Jim). "The History and Development of the English 'Admiralty' Anchor, ca. 1500-1860" (1993).
- Kitson-Mim Mack, Joy. "The Glass Beakers of the Eleventh-Century Serçe Limanı Shipwreck" (1988).
- Lakey, Denise C. "Shipwrecks in the Gulf of Cadiz (Spain): A Catalog of Historically Documented Wrecks from the Fifteenth through the Nineteenth Centuries" (1987).
- Lamb, William R. "The Provenance of the Stone Ballast from the Molasses Reef Wreck" (1988).
- Lang, Shelley Ruby. "The *Mittie Stephens*: A Sidewheel Steamboat on the Inland Rivers, 1863-1869" (1986).
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- Lloyd, Manuela F. "A Byzantine Shipwreck at Iskandil Burnu, Turkey: Preliminary Report" (1984).
- Lyon, Jerry D. "The Pottery from a Fifth Century B.C. Shipwreck at Ma'agan Michael, Israel" (1993).
- Mark, Samuel E. "A Study of Possible Trade Routes between Egypt and Mesopotamia, ca. 3500-3100 B.C." (1993).
- Marquez, Carmen. "Cultural Contributions to the Island of St. John, United States Virgin Islands; Underwater Historical Archaeology at Cruz Bay" (1995).
- Matthews, Sheila D. "The Rig of the Eleventh-Century Ship at Serçe Limanı, Turkey" (1983).
- McClenaghan, Patricia. "Drinking Glasses from Port Royal, Jamaica, circa 1660-1850: A Study of Styles and Usage" (1988).
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Review

by Kevin Crisman.

Ships Bilge Pumps: A History of Their Development, 1500-1900

By Thomas J. Oertling

College Station: Texas A&M University Press,
Studies in Nautical Archaeology, Number 2. 1996.

ISBN 0-89096-722-9, 105 pages, softcover, \$17.95
(INA Members \$15.26).

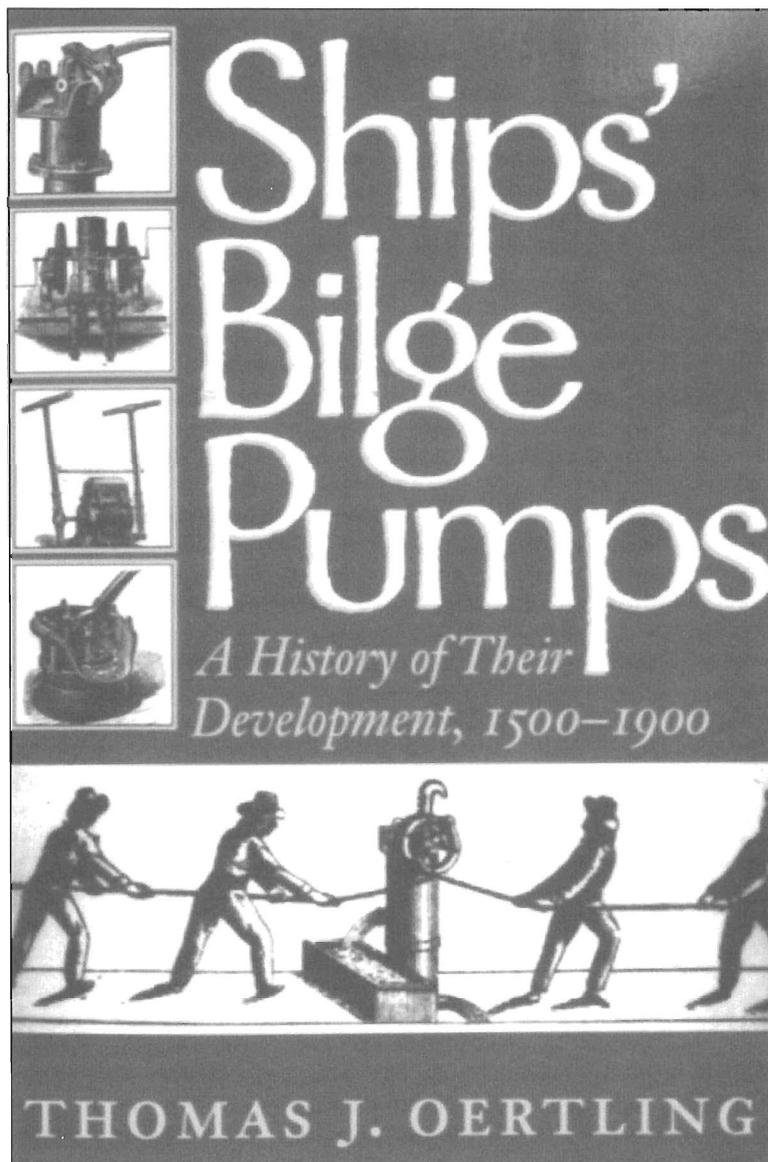
Before we examine Thomas Oertling's *Ships Bilge Pumps*, a confession is probably in order: the reviewer has a strong bias in favor of both the author and his work. Back in our salad days, the years of graduate training in Texas A&M's Nautical Program, Tom and I spent many a pleasant hour talking about his pump research; his enthusiasm for these humble devices was always infectious. Tom's extensive—and highly readable—study of the technology of ships' pumps was completed as a master's thesis in 1984, but I always hoped it would see much wider distribution, for it is beyond a doubt the most authoritative work ever written on the subject. At last, thanks to the Texas A&M University Press' *Studies in Nautical Archaeology* series, Tom's masterpiece is available to all.

In the book's introduction and in chapter one ("Of Leaks and Men") Oertling begins with a simple statement of fact: "all ships leak, and so some means of expelling excess water from the hull is needed." Without a pump, a ship will eventually fill with water and sink, a prospect that becomes more immediate when a vessel is damaged or stressed and begins to take on great quantities of water. Through a series of anecdotes describing nautical disasters, the author vividly illustrates the central role of the pump in saving ships and lives (and, on the reverse of the coin, the losses that result when pumps break down).

The technology of pump construction and operation is covered in the following four chapters. Chapter two briefly describes the materials, tools, and techniques required to construct pump tubes. Subsequent chapters examine the three principal types of pumps employed aboard ships between 1500 and 1900: the crude burr pump, the ubiquitous common pump, and the high-volume, high-maintenance chain pump. Characteristics of each type, construction methods, variations in designs, and operation are all discussed in Oertling's clear, concise prose. No stone is left unturned here, for Oertling expertly combines both archival data and archaeological examples of pumps to describe the advantages and disadvantages of each kind of pump, and to provide dates of their use. The delayed publication of this book has clearly had one beneficial result, the inclusion of a great many new and significant pump finds made since 1984.

Both Oertling and Texas A&M University Press can congratulate themselves on the number and excellent quality of the illustrations in the book. Photographs of archaeologically-recovered pump elements, scale archaeological drawings, cut-away diagrams, and contemporary prints are used to show the individual elements and working arrangements of every type of pump. A total of fifty-five illustrations are included, an impressive number in light of the book's modest length of 105 pages.

While ships' pumps may not be a subject that will delight and thrill every reader, this is a publication that no conscientious nautical archaeologist can afford to pass up. All large ships carried one or more pumps, and nearly every wreck contains evidence of their type and location. With Oertling's book it should be possible to quickly and correctly identify most pump finds from shipwrecks. The usefulness of this book was nicely illustrated this past fall (1996) when Joe Cozzi, a Nautical Program Ph.D. candidate and co-field director of the La Salle ship *Belle* (1686) excavation in Matagorda Bay, Texas, described an unusual cylindrical object of wood found on the wreck. It **sounded** pump-like, a suspicion that was quickly confirmed by checking an advance copy of Tom's book that the publisher had recently mailed to me. We were able to match the *Belle* artifact with a photograph of an upper valve body from the common pump of the French frigate *Machuault* (1760). I predict that in future years this book will be a standard entry in the bibliographies of most post-Medieval shipwreck excavation reports.



Review

by Samuel Mark.

The Development of the Rudder: A Technological Tale
by Lawrence V. Mott

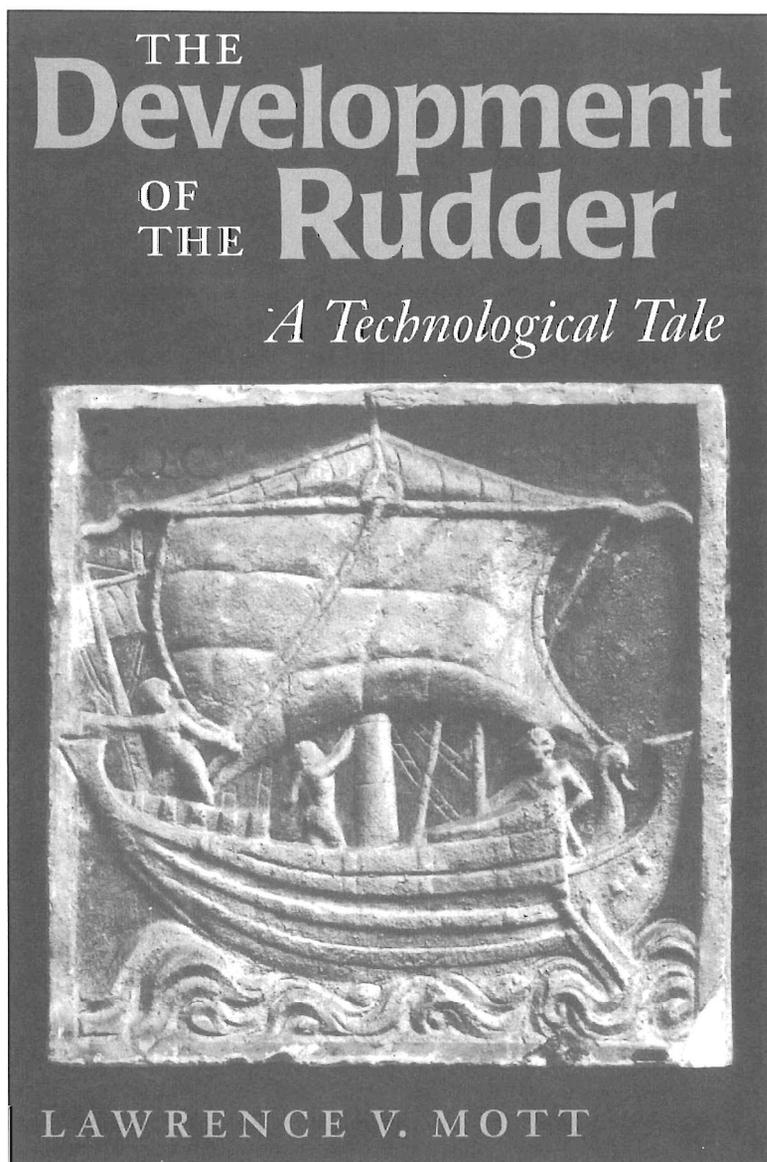
College Station: Texas A&M University Press,
Studies in Nautical Archaeology, Number 3. 1997
ISBN 0-89096-723-7, 218 pages, softcover, \$19.95
(INA Members \$16.96).

Considering that the rudder is one of the few devices that all ships have had in common throughout history, it is no surprise that its evolution has been a topic of debate since the nineteenth century. *The Development of the Rudder: A Technological Tale*, the third title in the *Studies in Nautical Archaeology Series* from Texas A&M University Press, is a worthy addition to this debate. It is one of the most thorough studies yet produced on the development of rudders.

Unlike previous authors that only looked at narrow aspects of this development, Lawrence Mott brings together primary sources and writes a lucid account that spans the Roman period through the Age of Discovery. Most of the book concentrates on the construction, mounting, and hydrodynamics of quarter rudders. The mounting of two rudders on the stern quarters of a vessel provided a simple and effective means of control that was in use throughout the Mediterranean as early as 2500 B.C. and continued in use on most ships until the thirteenth century A.D. By drawing upon iconographic and textual evidence in the framework of hydrodynamic theory, the author produces a fascinating look at the way in which this rather simple system was refined and adapted to fulfill the needs of various types of ships. Unlike earlier publications, Mott emphasizes the importance of the mounting systems; the various mountings allowed considerable flexibility in the design and adaptation of quarter rudders.

The last two chapters discuss the probable origin and development of the pintle-and-gudgeon rudder, the rudder system that replaced quarter rudders in Europe and the Mediterranean. Mott goes into considerable detail in outlining the strengths and weaknesses of each system. He explains why quarter rudders continued to be used long after the knowledge and technology necessary for their replacement by the stern rudder had been acquired.

This tale succeeds on a number of different levels. The illustrations, citations, and bibliography, alone, makes this volume invaluable to the serious student of nautical history and archaeology. At the same time, the large number of illustrations, the glossary, and the style of writing results in a work that is accessible to everyone, even if they have little or no background in this subject. Finally, for those with an interest in physics and mathematics, two appendices are included that explain the flotation models that are a basis for this study.



Nautical Books to be Released

The Texas A&M University Press has announced the forthcoming release of *From Egypt to Mesopotamia: A Study of Predynastic Trade Routes* by Samuel Mark (see above and bottom picture on page 3). This November publication will be the fourth volume in the *Studies in Nautical Archaeology* series. The book is based on Mr. Mark's M.A. thesis, described on page 27 of this issue. The Press has also announced the December reissue of Number One in the series, *Those Vulgar Tubes* by Joe J. Simmons III (page 21 of this issue).

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