INA NEWSLETTER
VOL 14 NO 3/4
January 1988

HIGHBORN CAY WRECK

A Discovery Hull Is Exposed

The main mast assembly
and associated architecture
of the Highborn Cay Wreck

August 30: *Crossing the Gulf Stream was easy, and it took no effort to get sea-legs, although we all did stagger like drunks for awhile going from Point A to Point B. Jack walked by with a cup of coffee in hand, leaving much of the beverage in a zig-zag trail behind him. When I chuckled, he noted wryly that his wrist had not yet become gimbled. Some people slept, some read, but most of us just wandered around the ship, grinning from ear-to-ear at the pleasure of being at sea again.*

By KC Smith

INA archaeologists begin to clear ballast and overburden from the Highborn Cay Wreck, which was excavated during a three-week period in September 1986. The excavation revealed stunning hull remains from one of the oldest known shipwrecks in the Western Hemisphere. (Photo above and on cover: KC Smith) This issue of the Newsletter *was edited by KC Smith.*

We all kept journals or logs—albeit, some more diligently than others because some of the crew had more details to remember and to record. Project Director Don Keith earned the gold star for volume and faithfulness of written data entry. His chronicles of our project extended through several 9x7-inch notebooks, which he filled daily with carefully scripted pages, often embellished with precise illustrations.

Denise kept her primary records in three-ring binders that conveniently held computer-generated pages of the project inventory, pertinent historical documents, and administrative records relating to our mission. On these, she constantly scribbled updates. Joe, on the other hand, had a small, conventional fieldbook in which he made notes about site plans, drawings and impressions; they will be some future scholar's bonanza of detailed information. Roger kept an organized log of the videotapes he was making on a lined tablet. Jack, Ric and Pilar earnestly maintained a range of journal types, in which they documented their daily activities and experiences.

My own journals comprised two notebooks: one that contained data—notes from daily crew meetings, the photo logs and artifact records, and cryptic messages to myself about tasks to be done; and one that was entirely impressionistic in content. I reread both recently and was reminded of the satisfying and successful project we had had.

In three brief weeks, we accomplished a remarkable task. Our team of eleven people—comprised of professional archaeologists, novitiates to archaeology, and experienced volunteers—excavated enough of a rude, humble ballast pile off a remote Bahamian island to answer questions that have been posed for decades, and to pose questions for decades to come. The

Bahamian Expedition Yields New Evidence Of Early Ships

queries concern how early 16th-century vessels of exploration and discovery were constructed and appointed. We retrieved sufficient information from one of the oldest known shipwrecks in the Western Hemisphere to begin to offer a confident explanation.

Before we visited the site at Highborn Cay, we already had a sense of the ways in which Spanish colonial ships were outfitted because of INA's ongoing excavation of the Molasses Reef Wreck (MRW) in the Turks and Caicos Islands. Eight tons of concreted artifacts had begun to yield ship's fittings, ordnance, hardware and personal effects—the objects that explain the operation of a vessel and how people conducted their lives and business on a floating time capsule. What the Molasses Reef site had not provided was evidence of the ship that made it all possible. Less than two percent of the architecture remained on the seabed.

The Highborn Cay Wreck promised to fill in these details.

The site was discovered in 1965 by Florida sport divers Clint Hinchman, Jack Robinson and Robert Wilke. While skin diving off the northern shore of Highborn Cay, they encountered a meatloaf-shaped pile of ballast and an assortment of ordnance and anchors, hazily obscured by a dense coat of coral at a depth of 7.3 meters.

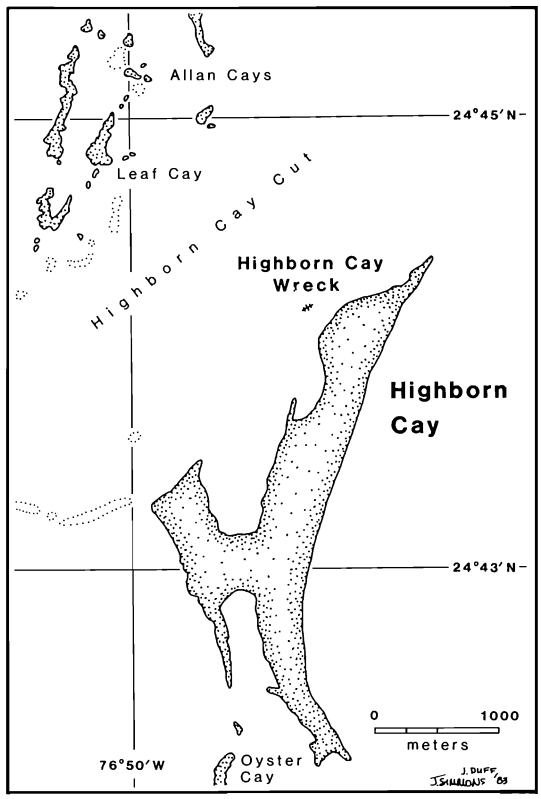
With assistance from the former owner of the island, the late William Wykoff Smith, permission was received from the Government of the Bahamas to excavate the site. The three discoverers began working in March 1966, aided by salvage experts Mendel Peterson, Teddy Tucker and Robert Canton. Peterson, former curator of military history at the Smithsonian Institution, authored the only published account of the salvage; and Tucker and Canton, salvage divers and amateur historians from Bermuda, produced sketches of the ordnance and hull remains.

Most work at the site was conducted between January and May 1967, funded by a grant from the National Geographic Society. The salvors primarily raised large iron artifacts, although an assortment of small items also was recovered. The spoils were divided among the discoverers, with a few objects being retained by the Smithsonian.

After this initial salvaging, the Highborn Cay Wreck (HCW) faded into obscurity until INA began excavation of the Molasses Reef Wreck. Pouring through literature on early New World shipwrecks in search of artifacts analogous to items found on the MRW, researchers reviewed Peterson's 1974 National Geographic report about the HCW. Quickly they realized that not only were there similarities between the ships' hardware and ordnance, but there also were similarities in the distributions of these objects on the seabed.

Through Peterson, the INA team began to track the discoverers and others who were involved with the salvage at Highborn Cay, acquiring information about the shipwreck and the whereabouts of recovered artifacts. With permission from the Bahamian government, INA conducted a brief survey of the site in April 1983, during which researchers concluded that substantial hull remains probably were preserved beneath the ballast. When it became clear that a final field season at Molasses Reef would be undertaken in 1986, members of INA's Ships of Discovery Project decided it would be opportune to visit Highborn Cay again, this time to uncover the hull.

The results of that effort are the focus of this *Newsletter,* reported from various perspectives, whimsical to scholarly. In preparing our articles, most of us drew on information detailed during the expedition in journals and logs—volumes which provide a wonderful record not only of facts but of feelings as well.



Map of the Highborn Cay wrecksite. (Illustration: Joe Simmons and Jim Duff)

August 30: Though some of us celebrated our departure and Jody's birthday well into the night, we all were up early this morning to secure everything—inside, outside, up-top and down below—to get underway. We are heavily laden with equipment and provisions, and if this mission fails, it won't be because we lacked a tool. Indeed, about the only way we could be more prepared is to start over from scratch.

Planning Insures Field Success; But What About The Leftovers?

By Mark Myers

There was never any question about our going to Highborn Cay—merely how and when we would do it. In our study of 16th-century vessels of exploration and discovery, we simply could not pass up the chance to investigate a shipwreck of this period that was reported to have extensive wood preservation. Though nearly eight tons of artifacts already had been excavated from the contemporaneous Molasses Reef Wreck (MRW), its hull remains had been disappointing, with only about two percent of the wood extant. Evidence which the MRW lacked, we hoped the Highborn Cay site would provide.

Our first challenge—no small task—was to obtain the necessary funding. In general, it is easier for an archaeological project to secure support for fieldwork than for a conservation and research laboratory; and with the MRW Project still in full swing, we knew we would have to convince potential sponsors that we were not biting off more than we could chew.

Fortunately, in stepped the Meadows Foundation. Pointed our way by INA Archaeological Director Dr. George Bass, representatives of the Texas-based foundation who visited the MRW research facility in College Station expressed interest in our Ships of Discovery Project; it seemed to be just the sort of program they were seeking. Confident that the results of fieldwork at Highborn Cay would be dramatic, we requested funding for a three- to four-week limited excavation on the Bahamian shipwreck. The Meadows Foundation agreed, and the first hurdle was cleared. This organization was only one of many which ultimately provided financial or in-kind support to the project.

The next problem—one which our land-based colleagues never have to consider—was the dilemma faced constantly by maritime archaeologists: obtaining an adequate research vessel at a reasonable price. To our complete surprise, we were quickly offered a *very good* deal on a *perfect* vessel, and naturally we jumped at the proposed arrangements, planning to depart for the field on April 1, 1986. However, as we all have been told, if something seems too good to be true, it probably is. The deal fell through, and we were back to square one.

We didn't realize it at the time, as we sat glumly in College Station considering the alternatives; but in retrospect, this turn of events probably was one of the best things that ever happened to our project. The resulting hiatus, which extended until late August, allowed us to assemble an amazingly well-equipped and well-prepared expedition. Throughout the period during which we were hunting for the perfect research vessel, at the perfect price, we were fine-tuning our equipment lists. By the time we decided on the R/V *Coral Reef II,* we had obtained everything that we possibly would need except perishable foodstuffs. We also had consolidated a research strategy that would enable us to maximize our brief field time.

Most of our supplies were purchased below retail cost, and some were acquired for free, but the process of acquisition was not without its duress. Shopping for a bargain is a task that everybody loves to do, but as we discovered, it can become a chore if the equipment is something you *need* but cannot afford unless someone gives you a break. For example: for the price of a new inflatable boat or an outboard motor, you can purchase a really good used car; for the price of both pieces of equipment, you can just about buy a new one. While we were never able to arrange the deal of our dreams on an outboard engine, an eighteen-foot, cherry-red Achilles inflatable boat, acquired through patient negotiations at two-thirds the price of many comparable brands, became the pride of the project.

Arranging to lease the *Coral Reef II* was the crowning achievement in our hunt for the best for the least. She is the official research ship of the John G. Shedd Aquarium in Chicago, and if we are lucky, we will never again have to use any other vessel. At a rate nearly fifty percent below all other vessels we considered, the savings enabled us to use surplus funds for other critical purchases. In addition, the layout and accommodations of the ship were perfect for our needs.

Moreover, the *Coral Reef II* had an attribute that proved to be even more indispensible and important. When one is at sea in close quarters, it is the people who count. Her co-captains, John Rothchild and Lou Roth, went far beyond the call of duty for our project. They became involved in every aspect

The Highborn Cay Wreck excavation was conducted from the Coral Reef II, *research vessel of the John G. Shedd Aquarium of Chicago. (Photo: Project staff)*

of our work, from diving to cooking, not to mention their capabilities as marine pilots, and we gladly considered them as team members.

Our efforts to plan and to prepare for the Highborn Cay fieldwork were well rewarded. With swat-team efficiency, in a mere three weeks the eleven-member crew excavated and examined three critical areas of the shipwreck, copiously recording every detail with notes, drawings, photographs, and videotape. The ease with which this was accomplished, and the camaraderie experienced throughout, were facilitated because necessary tools were available, good food sustained the crew, and the accommodations were convenient and hospitable.

As with all INA fieldwork, we returned to College Station at project's end with abundant memories, a satisfying body of data, and the large task of assimilating this new information into our growing understanding of the earliest ships to visit the New World. The wealth of knowledge revealed about this vessel's construction has been reported in a forty-page document assembled for the Government of the Bahamas by team member Tom Oertling. The information also was incorporated into the recently completed dissertation of Project Director Dr. Donald H. Keith, and will be used in a dissertation in progress by INA Research Associate Roger C. Smith. In addition, hours of videotape of the excavation, recorded with an 8 mm camera system provided by the Sony Corporation, have been synthesized into a short documentary under Smith's direction.

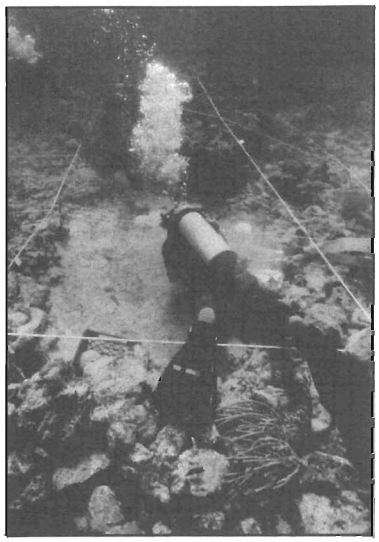
However, such lofty goals and projects must be shared with more temporal concerns which sometimes range from the sublime to the absurd—and which sometimes reveal just the tiniest flaw in the initial preparations. It was easy for us to unpack and to store our tools; to winterize engines and compressors; to return borrowed gear; and to disassemble kits and equipment. But what in the world were we supposed to do with the gallon-size packages of pudding mix, #10 can of beans, chinese vegetables and instant mashed potato buds, and twenty pounds of leftover grits?

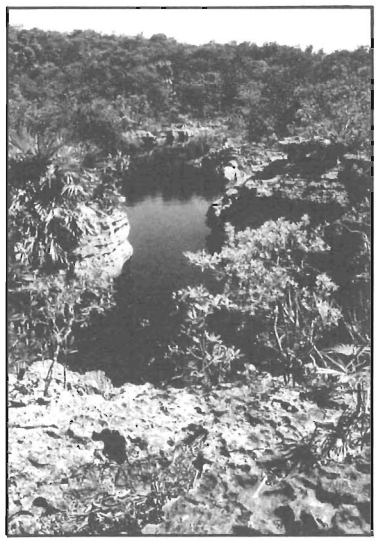
THE SPONSORS AND SUPPORTERS

Excavation of the Highborn Cay Wreck was possible because many people and many organizations were willing to aid the research through financial and in-kind support. We are indebted to:

J.H. Baird
Charles Beeker
G. Roger Edwards
Florida State Museum
Government of the Bahamas
Ric Hajovsky
Peter Haven
INA Board of Directors
Walter and Bette Lane
Mariner's Museum
Meadows Foundation
Miller Blueprint
Paramount Movers
George Parker
Pepsi-Cola Bottling Company
Mendel Peterson
John Sands
John G. Shedd Aquarium
Sony Corporation
Texas A&M Department of Oceanography
Texas A&M University
Underwater Research Products International
F.H. and Wilda van Doorninck
R.S. and M.K. Webster
Robert Wilke

August 31: *We anchored at HCay at 2:40 p.m. and immediately had a meeting to establish routines and to outline work priorities. The former touched on galley and garbage duty, the watch schedule, safety, harmony and morale. The latter included discussions by RCS, JJS and DHK about our primary objectives—the area survey, the wood and ballast—and our immediate equipment needs, i.e., items to assemble and break in. We also have to locate the site.*





Left: *Lying on the seabed in the "shadow" of the ballast mound, Don Keith avoids the force of the current while he excavates the stern area comfortably.* Right: *The limestone rock surrounding this large pool of brackish water in the interior of Highborn Cay was found to be inscribed with names, initials and dates. (Photos: KC Smith, Don Keith)*

Three Goals Set, Reached During Three Weeks At HCay

By Donald H. Keith

We went to Highborn Cay to accomplish three things: to determine the extent of hull remains preserved beneath a small, low mound of ballast; to recover ballast samples for comparison with the Molasses Reef Wreck; and to survey Highborn Cut and Highborn Cay for evidence of other shipwrecks, aboriginal occupation and the presence of fresh water.

Departing Miami on August 30 aboard the R/V *Coral Reef II*, we entered the Gulf Stream headed for the Bahamas. After clearing customs in Nassau, Captains John Rothchild and Lou Roth expertly piloted the ship across the Yellow Bank from Nassau to Highborn Cut, saving us two days of cruising time that would have been required to steam around the Bank to enter Exuma Sound from the south.

Survey and site preparation

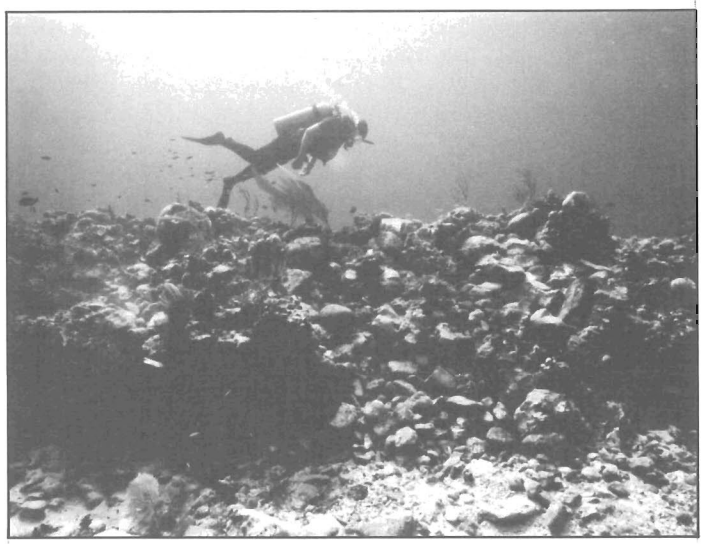
Once we reached Highborn Cay and were anchored a few hundred yards offshore, adjacent to the site, the first order of business was a magnetometer survey of the area to determine whether any large ferrous objects, such as anchors or cannons, had been missed by the original salvors. This also gave crew member Roger C. Smith an opportunity to determine whether the site, now virtually stripped of all ferrous artifacts—like the Columbus caravels he had been searching for in Jamaica—had any discernable magnetic signature.

The ballast mound gave off no detectable signature; however, we did discover four concrete-filled oil drums which the original salvors had placed around the site to use as moorings. This was good news to Captains Rothchild and Roth, who figured out how to place the *Coral Reef II* directly over the site using all of her anchors as well as the drums.

The wrecksite was only about 7 m deep, so our bottom time was limited only by our stamina. A very strong tidal current, occasionally exceeding three knots, runs through Highborn Cut. We discovered that, once on the bottom, a diver could work safely and in relative comfort by taking a position in the "current shadow" of some large, stationary object. Trips back and forth between the surface and the bottom, however, were risky.

While Roger and two others continued the survey of Highborn Cut, the rest of us concentrated on preparing the site. Because of the limited time we would spend at the site, we needed an accurate grid system that could be installed quickly, and chose to use heavy line secured to iron stakes. Ric Hajovsky and

A meter-wide transverse trench in the center of the ballast pile was widened further as evidence of the main mast assembly emerged.



At the completion of the project, the trench was refilled with sand and ballast, and "seascaped" with coral heads and sea fans which earlier had been removed. (Photos: KC Smith)

Jack Hunter were given the arduous task of driving the stanchions into the hardpan bottom at grid-line intersections, followed by Pilar Luna and C. O. Myer, who carefully laid out the line. When our positioning system was set, we began excavation at both ends of the ballast mound. Taking advantage of the current shadow created by the mound, we uncovered the stern of the wreck when the tide was rising, then switched work to the bow when the tide began to fall.

Throughout the excavation, we each tended to work in a particular area of the wreck—either at the bow or the stern, or in a transverse trench placed across the middle of the ballast mound. Concurrently, each of us had other duties or problems to address to expedite the research. While Roger recorded the progress of the project on videotape, Denise Lakey wrestled with the difficult problem of making a reliable determination of the volume of ballast which the ship had carried. In addition to his daytime duties as divemaster, Joe Simmons burned the midnight oil to keep the site plan up to date. KC Smith served as expedition photographer and artifact recorder, and also was responsible for deploying a submersible electronic array called the Hydrolab 8000 at regular intervals to log water temperature, salinity, dissolved oxygen, and other environmental parameters in the area.

Without doubt, our success at Highborn Cay was due in large measure to the energetic, enthusiastic assistance of the *Coral Reef II* co-captains, John and Lou, and to the extremely competent volunteers—Pilar, Jack, C. O. and Ric—who, collectively, comprised more than half of our complement of personnel. In one day, our eleven-person team logged forty-five hours underwater.

The evidence emerges

As the excavation began to unfold, the first thing we encountered was a curious linear trough in the hardpan at one end of the ballast mound, apparently dug by the ship's keel as the vessel had wallowed from side to side before becoming permanently affixed to the seabed. The outermost point of the trough marked the after end of the now-absent keel. As we continued to excavate closer toward the ballast mound, however, wooden remains became more intact: we uncovered the remains of the keel, then the garboards and other strakes, floor timbers, ceiling planking, and the keelson. At the other end of the mound, in the bow, we discovered a similar "keel-trough" in the hardpan, but here the hull remains were surprisingly intact. The stempost was scarphed to the forward end of the keel; and although floors and futtocks forward of this scarph had disintegrated, their locations were indicated by lines of iron nail-head impressions concreted to the hardpan.

We had the two ends of the ship, but several pieces of information critical to our understanding the ship's design and dimensions were still missing. If we could locate the "amid-ships bend," the widest part of the hull, we could determine something about her lines. Accordingly, we began to excavate a meter-wide trench across the mound, which eventually came down on the main mast step. Extending the trench forward one meter exposed the "master couple," an unmistakable shift in the framing pattern that signals the widest part of the hull. Ballast stones exposed in the forward profile of the trench were mapped using the video camera, and specimens representing the most common rock types were selected for petrological analysis and comparison with the Molasses Reef Wreck samples.

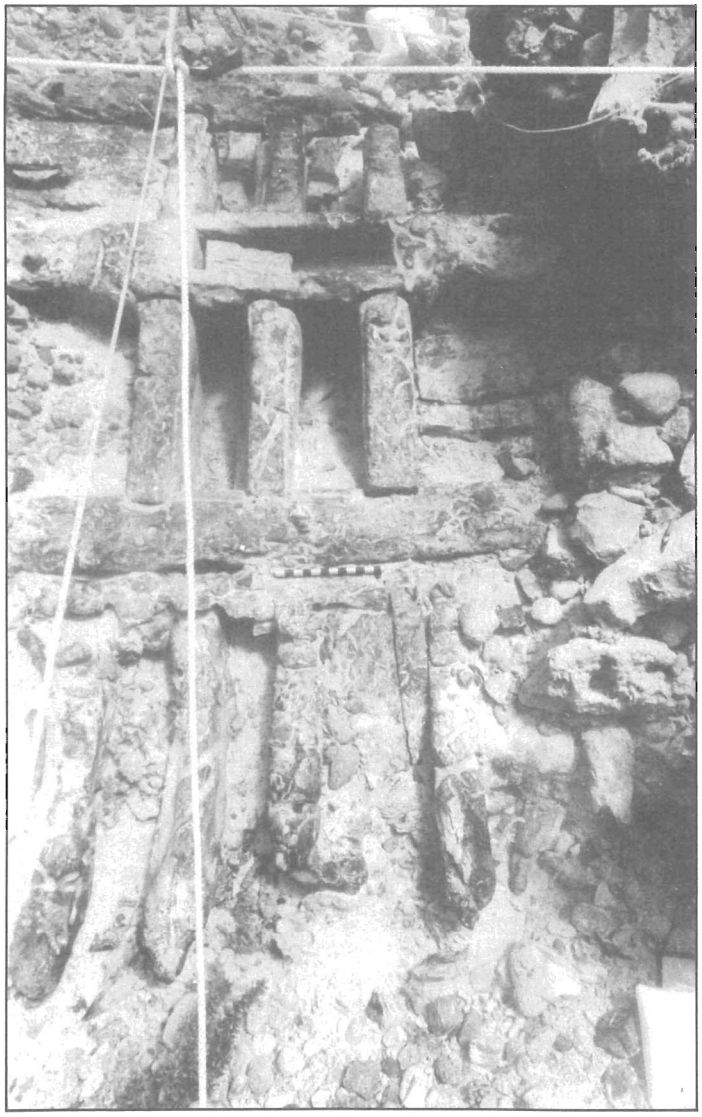
At intervals during the three weeks we spent at Highborn Cay, we dispatched small teams to investigate the northern end of the island. The most successful team, Ric and Jack, learned that the western side of the island is peppered with sinkholes containing abundant fresh water reserves. Ric dived in one of these and discovered that the bottom was covered by a thick layer of rich organic muck. During one excursion, they made an incredibly lucky discovery: a small polished stone celt, which they found on the beach just opposite the wreck site. This find affords strong evidence that Lucayan Arawak Indians at least visited, and may have lived on, Highborn Cay. Were they the reason why this ship came to Highborn Cay? Or were both Indians and Spaniards attracted to the location by the same indispensible resource: drinking water?

Three days before we were due to leave Highborn Cay, we began to backfill the exposed portions of the ship and to "seascape" the underwater terrain. Our last effort was to install a sign on top of the ballast explaining that the only "treasure" which the site contained was its historic worth, and asking anyone who might chance upon it, to please leave the shipwreck undisturbed.

September 11: Days of digging in the center trench have revealed a mast step assembly so complete that even the old hands, Roger and Don, are flabbergasted. We had a major discussion this p.m. about its construction . . . . Meanwhile, amid the scholarly business, we deal with attacks from pirate ghosts: the Aquasport started itself today. The painter somehow got wrapped around the key and throttle; when the boat swung on the line, it caused ignition and revved the engine wildly.

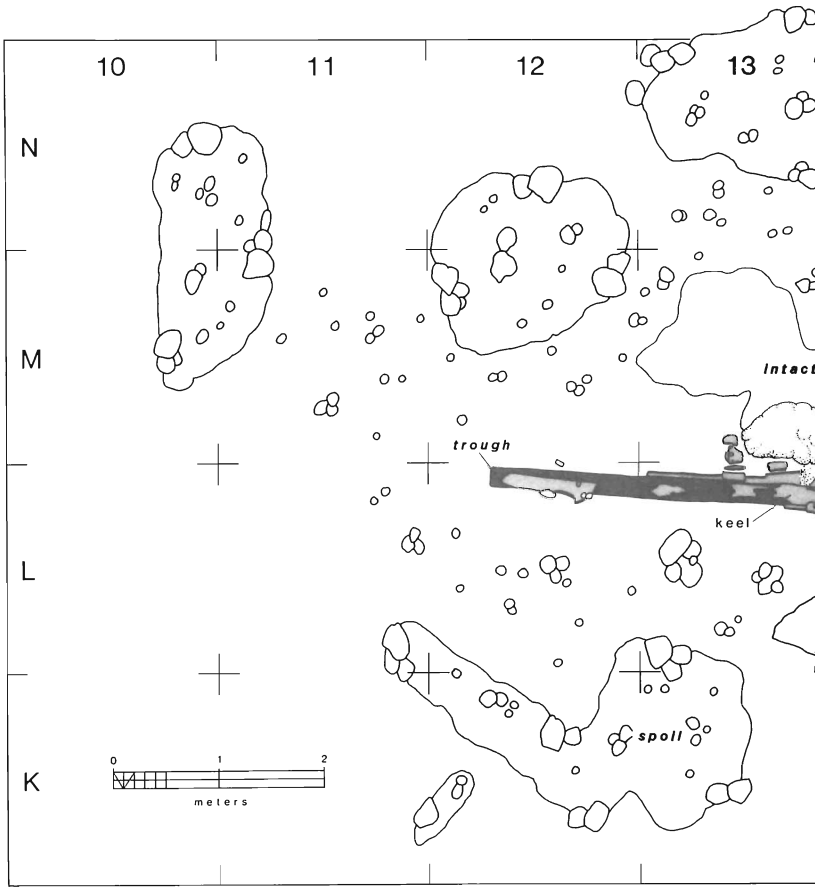
Elegant Rem
Of Discovery

By Thomas J. Oertling



The reason for investigating the Highborn Cay Wreck was the good prospect of well-preserved hull remains. Among all of our studies in the Caribbean relating to vessels of exploration, only the Molasses Reef Wreck had yielded any preserved wood, and this represented only about two percent of the entire hull.

To gain the maximum amount of knowledge in the short time allotted at Highborn Cay, we decided to excavate only specific portions of the hull. The features we wished to find and to examine were the main mast step; the "master couple," or midship frame—the point along the keel at which the maximum breadth and calculated depth of hold is placed; the forward end of the keel where it joined the stempost in a scarph; and the curvature of the remaining frames. In addition, the measurements



Site plan of the Highborn Cay Wreck shows areas of excavation and hull remains uncovered by INA archaeologists. Photograph of the main mast area (port side in foreground) reveals major construction features including a wedge found in the mast step. Aft of the step, one of two pump sumps is seen as a semicircular hole in the lower side of the keelson. (Plan: Joe Simmons; photo: KC Smith)

nains Yield Details
y Ship Construction

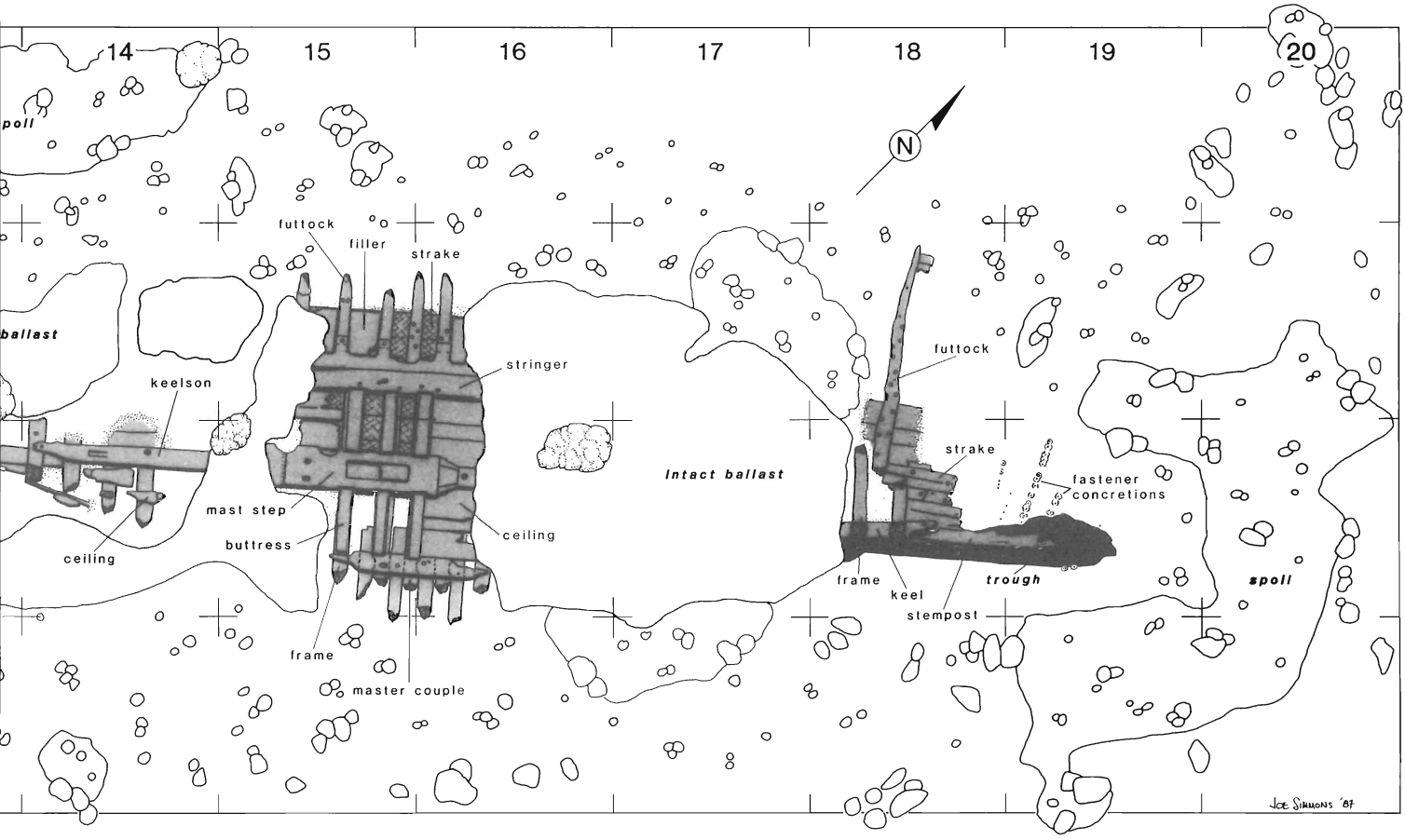
of all major timbers were to be compiled in a list of dimensions, called "scantlings," that could be used to compare the Highborn Cay Wreck to other vessels of the period.

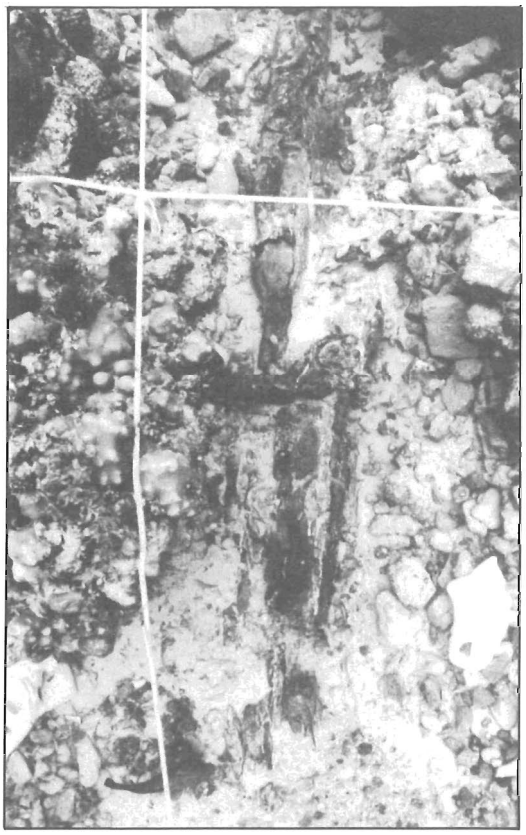
The site consisted of a mound of stones, approximately 1.5 m high, 4 m wide, and 10 m long, aligned in a NE-SW orientation. The surrounding seabed was flat, bedrock, "hardpan" plane, slightly undulating, covered by sea fans and occasional small coral heads. Most of the area was covered by a few centimeters of sand, although northern sections revealed a heavy layer of sand, up to 40 cm deep.

Digging the bow and stern

Excavations began in the bow and the stern by cleaning away overburden and loose ballast stones which still covered areas worked by the salvagers in the 1960s. In the stern were fragments of the keel, five partially preserved frames, and two frame positions indicated by erosion marks on the keel. Above the frames were a few fragments of ceiling planking and the eroded stern end of the keelson, with a rectangular mortise cut into its upper surface. Several hull planks were preserved under the frames near the intact ballast. As a general rule, the closer the wood was to the intact center of the ballast pile, the better it was preserved.

As the ship lay on the bottom after it sank, the movement of the hull by the current caused the keel to gouge out a trough in the hardpan before the ship fell apart and settled on the ocean floor. The abrupt terminus of the trough showed the farthest extent of the keel aft.





Left: *Excavation of the stern exposed remains of the keel, frames, keelson, and hull and ceiling planking.* Above: *In the bow (port side in foreground), the INA crew uncovered remains of the stempost, keel, planking and futtocks. Rows of nailheads concreted to the bottom revealed the positions of five frames. (Photos: KC Smith)*

In the bow, the keel and stempost—again resting in a trough in the hardpan—were joined by a vertical scarph, giving us both extremities of the keel. A few strakes of planking on the port side underlay the two frames and one futtock that were exposed. Forward of these timbers was a series of nail heads—nails that had held hull planking to the frames—concreted to the hardpan, marking the positions of five more frames. Two additional frame positions were revealed by fasteners in the hull planking, for a total of nine frame positions exposed in the bow.

The midship trench

To find the mast step, a one-meter-wide trench was dug at approximately the midpoint of the overall remains, coinciding with a depression in the top of the ballast pile. This revealed an expanded portion of the keelson that had served as the mast step. Nearly 1.95 m of the step, estimated at 2.25 m total length, was exposed by widening the trench in both directions.

The step featured a large mortise that once held the heel of the main mast, and a wedge or spacer in the mortise to keep the heel of the mast from shifting. The keelson was notched on its lower surface to fit over the tops of the frames and to lock them in place. Two semicircular holes cut into the port side of the mast step had served as sumps for the ship's pump(s). A small mortise in the top of the keelson on the starboard side probably was for a stanchion supporting the walls of the "pump well"—a box which surrounded the pump to protect it from cargo and ballast. The collapse of the well had allowed ballast stones to fall into the cavity, causing the depression noticed by the archaeologists.

Three pairs of buttresses reinforced the mast step laterally in the immediate vicinity of the mortise. The buttresses, lying atop floor frames, were notched into stringers on their outboard ends. An interesting feature of the buttresses was that they were not fastened to the frames, the mast step, or the stringers.

For 0.65m on either side of the keel, the ship's bottom was very flat; there was very little "deadrise," or rise in the arms of the floor frames above the top of the keel. However, the first futtocks definitely showed the beginning of the "turn of the bilge." The futtocks, extensions of the floors, were attached to the ends of the floor timbers by trapezoidal mortises and tenons; and, although no fasteners were noted, treenails or bolts probably were used to hold the two timbers together.

Between the stringers and the keelson, except in the spaces between the buttress timbers, were three strakes of ceiling planking. Another strake of ceiling, placed on the outboard side of each stringer, was notched to receive a short board, called a "filler," which touched the ceiling plank at one end and the hull planking at the other. The filler planks filled the spaces between the futtocks. Small pieces of plank were treenailed on the outboard side of this last ceiling strake to give a finished appearance to the ceiling. Short planks were lain athwartship in the spaces between the buttresses on rabbets in the upper edges of the buttresses.

The master couple

The master couple, or midship frame, was located beneath the forward end of the mast step and was identified through several clues. In general, the frames throughout the entire ship were spaced an average center-to-center distance of 40 cm. However, three frames under the forward end of the mast step were spaced, center-to-center, only 30 cm apart. The middle frame had futtocks on both the forward and after sides, but there was no trapezoidal mortise and tenon joining the frame to the aft futtock. Forward of this frame the futtocks were joined to the forward face of the floor, and aft of this frame the futtocks were joined to the aft face of the floor.

Although three floor frame curvatures were traced, the frames were so eroded that their usefulness in determining the

Continued on Page 15

September 8: Denise was looking for something today and naturally grabbed the inventory notebook from the "data shelf" in the salon. This made me consider the time-spanning pile of papers stored in this cubbyhole: project documents, permits and letters; historic texts, references and records; log books, data sheets, drawings, videotapes, and the inventory. The history of this shipwreck from then to now is chronicled on that shelf. Clearly, if our ship starts to sink, this is the stuff we should lunge for.

Records Usually Conceal The Happenstance Of Life

By Denise Lakey

Waşton Kendy Jonz flipped off the power to her console, leaned back in her chair, and rubbed weary eyes. How can five hours pass so quickly, but leave one so tired? she wondered. Reading digitized codes on five hundred-year-old floppy disks wasn't easy, especially with all of the gaps—or "lacunae," as scholars called them—caused by centuries of negligent storage in hot, dust-filled warehouses. Her work was both intriguing and tedious. Incredible detail concerning shipboard life on an early archaeological expedition could be gleaned from these inventories; but how long would it take to interpret them?

Certainly, the expedition's inventory offered insight into 20th-century diet: cereal, crackers, fruit drink, canned fruit, pancake and biscuit mix, and—believe it or not—garden snails. Waşton hoped these people who called themselves "INA" had had means to supplement such dreary, disgusting fare; yet no fishing gear was listed on the inventory, except for a hook and line in a "survival kit."

Even more difficult to interpret would be the ambiguous entries—cryptic identifications such as "some goop/anti-seize stuff" or "three-inch hose end things." Fortunately, someone on the project had had the good sense to group similar items by container and to label each one—"excavation tools," for example. Yet Waşton mused on the fact that sometimes the inventory described an item and its purpose in great detail, such as "eight orange freon cannisters for buoys."

November in *Sevilla;* the oranges are just beginning to ripen. 1986 is almost over, and I'm back in the Archive of the Indies, ferreting out clues to the daily lives of the people who first journeyed to the New World. I spend a great deal of time wading through expense accounts and inventories, a job I often find fascinating; but then, I loved to read the dictionary as a child.

Looking at the expenses of a fleet outfitted in 1495 to carry supplies and settlers to Christopher Columbus's colony at *La Isabela* on *Española,* I find their list of comestibles somewhat dull: wheat, hardtack, barley, wine, vineger, oil, salt pork, cheese, salted fish, lima beans. Surely they supplemented their diet with fresh fish. Ah ha, here it is: 1 *chinchorro;* a fishing boat, purchased in *Sevilla.* But what's this that follows? A list of the pieces of the *chinchorro:*

two dozen "thirty" at 500 maravedis/dozen
two dozen "twenty six" at 450 maravedis/dozen
two dozen "twenty" at 380 maravedis/dozen
four dozen "eighteen" at 330 maravedis/dozen
two dozen "sixteen" at 320 maravedis/dozen

Two dozen and four dozen whats? None of the definitions of *chinchorro* (fishing boat, fishing net) quite fits this context. As usual, one small entry in an enormous inventory of equipment and supplies will require research and comparison with other inventories before I'll know whether it refers to two dozen fish nets, two dozen fish hooks, or something else. Would I ever like to have a talk with the guy who made that list! I certainly did a better job on the inventory for our expedition to Highborn Cay . . . didn't I?

Final preparations for the 1986 field season—what a job! Dripping sweat from the Texas summer heat and thankful for an excuse to work in an air-conditioned room for awhile, the excavation team's "listmaker" leaves the equipment barrack for the computer room to make the latest additions to the inventory. On the way, she snickers to herself,

"I hope no one has too many problems figuring out what 'three-inch hose end things' are. I know how they are used, but what they're called, I haven't a clue."

A week later, the team is in Florida, still sweating, still purchasing supplies. The Shedd Aquarium van pulls up to the dock, and two hefty archaeologists begin to unload $700 worth of very frozen chickens and hamburger meat.

"Got a receipt for me?" calls the listmaker.

"Whaddaya think?" a tired someone growls.

An entry is made in the expense book: meat—$700. But no entry is made on the inventory. That night, the last of the receipts are gathered. Two are illegible; only the amounts can be deciphered. The other team members have found their respective bunks, while the weary listmaker, wishing to find hers too, enters in the expense book: Marine supplies, 4 dozen—$150.

She has one last chore before going to bed—to gather the ingredients for tomorrow's lunch of tuna casserole. That colored, curly pasta called "garden spirals" will do. Grabbing a zip-loc bag from the galley, she descends to the aft storage area. Struggling, she maneuvers a five-gallon plastic tub of pasta from the cramped closet, pries off the reluctant lid, scoops the spirals into the bag, hammers the cantankerous lid back on, and shoves the tub back in place, taking care that the words written in black marker face forward: Garden Snails.

September 3: Our first dives on the site today. By mid-way through my dive, I was utterly exhausted. Straining against a ferocious current, hearing my breathing become labored and anxious, gliding backward like so much flotsam, I wanted to abandon my mission and return to the boat. Had I not been so close to completion, I probably would have. The only consolation was that everyone had found the current awesome to work in. It will be a problem to be reckoned with.

Best-Laid Plans Often Need Ingenious Field Modification

By Joe Simmons

Proper prior planning and field ingenuity allowed our investigative team to recover an enormous amount of data during a brief three weeks at Highborn Cay. Through previous field experience, we knew what equipment and preparations would be mandatory. Knowing as well that we had finite time in which to answer some specific research questions, we developed new methods and adapted proven techniques, not only as we prepared for the project but also, of necessity, as the fieldwork progressed.

Marine operations

The extremely strong currents encountered at the Highborn Cay wrecksite quickly forced us to make some adjustments in our initial diving strategy in order to accomplish significant work. Upon arriving at Highborn Cut, we had anchored the *Coral Reef II* a short distance from the site, and for the first few days we attempted to work the wreck from small inflatable boats dispatched from the mother vessel. However, the process of entering and exiting the water, which sometimes was flowing by at a brisk three knots, presented safety hazards to the crew, and this strategy proved to be inconvenient in other ways as well.

We thus decided to moor the *Coral Reef II* directly over the site using a three-point anchor system. We relocated and, with great difficulty, repositioned cement-filled fifty-gallon drums that had been left at four corners of the site by the original salvors. These weights augmented the ship's own massive hook in holding us secure; still, the fierce currents demanded that the critical stern anchor line be monitored constantly for signs of excessive strain.

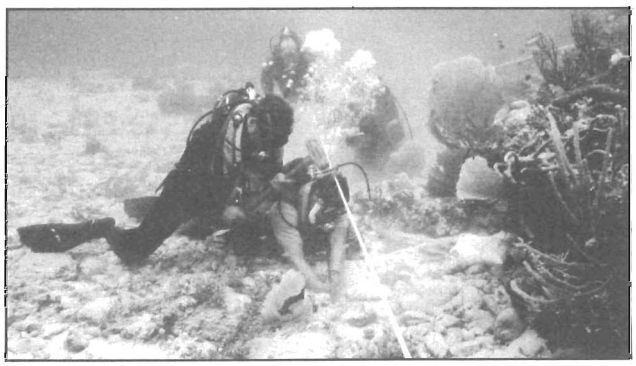
A drop line weighted with a sixty-pound lead ball was suspended from the stern diving platform to aid diver descents and ascents between the ship and the seabed. While the use of a down line was not innovative, the various techniques employed by divers to get to the bottom and to return to the boat were.

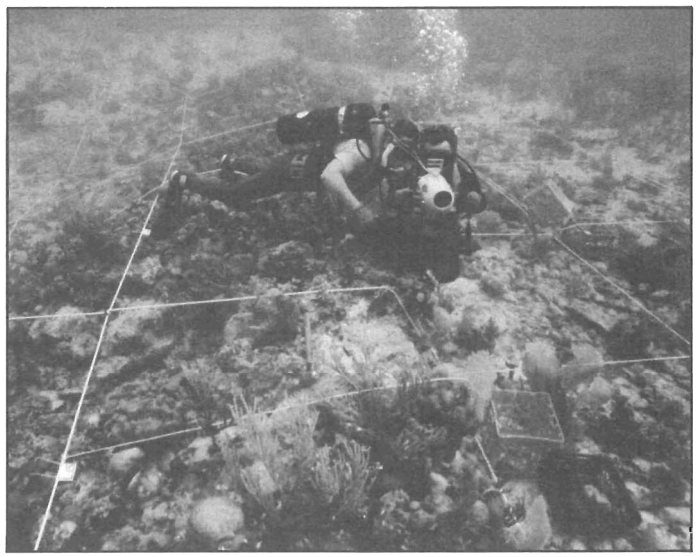
When the flooding tidal current was running into the stern of the vessel, entries were particularly dangerous since divers were at risk of being swept into the propellers and rudder of the ship. Entering the water on a small ladder suspended from the platform, divers reached over to the nearby drop line and descended on it without incident. If an ebb tide was running, a free entry could be made, though divers had to make for the bottom quickly, lest they be swept completely off the site. In this unpleasant case, they had to crawl along the bottom, clutching coral heads and sea fans, to get back to the work area, since swimming against the current was out of the question.

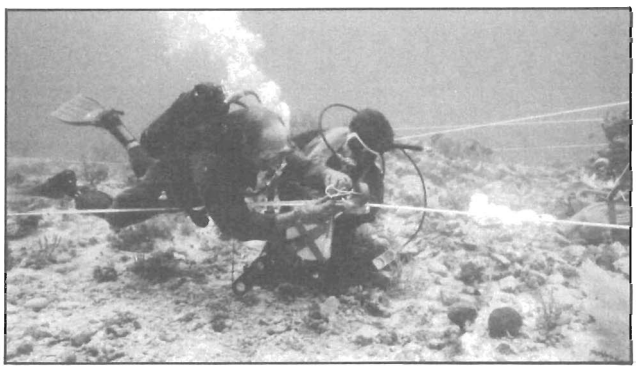
In either flood- or ebb-tide currents, the return trip from seabed to ship was somewhat trickier since divers had to connect with the drop line, which was suspended off the bottom about 2 m to prevent damage to the wrecksite. Before ascending, divers would crawl "up-stream" far enough, and in the correct direction, so that when they left the bottom and swam upward from the sea floor, the drop line could be snagged as they whisked by. If the line was missed, they shot to the bottom to crawl back and try it again; or they could grab onto the bow or stern anchor lines and call for assistance.

It was the responsibility of the surface safety personnel assigned during each dive sequence to remain on the afterdeck to aid divers with entries and exits and to stay atuned to prevailing conditions. Luckily, no incidents resulted from the serious currents, except for several bumped heads caused when divers nearing the top of the drop line were swung forward under the hull. In this difficult position—hanging forward of the platform, in line with the propellers and the rudder—divers had to pull themselves to safety, straining against the current.

Because the *Coral Reef II* was anchored in a fixed position, we had to consider the shifting of our small boats moored alongside since the current changed direction three or four times daily. Many problems were solved through the use of a simple outboard boom on which the small crafts' painters were attached. Suspended from ropes and bolted to the starboard side of the support ship, the boom could be raised and lowered without difficulty. Attached to a messenger-line that ran the length of the boom, a small boat could be pulled alongside or run out in a maneuver similar to that employed on laundry lines with pulleys.







A trusting Ric Hajovsky holds a corner stake for the grid while Roger Smith hammers it into the hardpan. Grid squares are checked for accuracy by triangulation with tapes by C.O. Meyer and Pilar Luna. Project videographer Smith takes the opportunity of slack tide to explain camera operation to Hajovsky. (Photos: KC Smith)

Nonetheless, the heavy currents constantly pushed the two inflatable boats and fiberglass runabout into one another and into the side of the big ship. We made abundant use of fenders, and over the transomes of the small boats we hung sea anchors to keep their bows firmly pointed into the current stream and away from the *Coral Reef II*. In addition, a twenty-four-hour watch schedule was set, involving all crew members except the captains, during which a primary responsibility was to monitor the small boats, the boom, and their lines.

Grid establishment

To facilitate the establishment of a precise 2-m grid across the Highborn Cay site, a set of pre-measured "triangulation-chains" had been prepared in College Station. Consisting of appropriate lengths of 0.5-cm chain with ca. 5-cm diameter steel rings at the intersections, the grid-chains were of various sizes—most based on a 3-4-5 triangle relationship: 1.5x2x2.5; 3x4x5; and $2x2x\sqrt{2}$ (distances represent meters). They allowed the relatively rapid erection of perpendiculars from various baselines and the gridding-off of those lines into 2-m squares. Resultant grid squares were checked with measuring tapes and found to be acceptably accurate, within ca. five percent.

Another time-saving device developed to aid the emplacement of the grid system over hard-bottomed areas was the pneumatic-powered "star" drill. Designed to sink starter-holes quickly for the reinforcing bar corner-stakes of the grid, this innovation unfortunately flunked its field test because of stress-induced failure of the weld between the star drill bit and the arbor shank inserted into the drill. We will attempt to modify the design for future use.

Video documentation

The work at Highborn Cay represented the first INA Caribbean site to be documented fully with an underwater and topside video system—a Sony HandyCam. Attempts to interface the video data with a personal computer, a Macintosh Plus, in order to generate computer-aided site plans were unsuccessful during sea trials due to undamped power surges from the *Coral Reef II*'s generators. However, dockside experiments with the video-computer system prior to our departure from Miami had been successful when shore power was used. Frames of video footage were digitized and printed out on a dot-matrix printer, and we had hoped to use shots of the site as efficient templates in the quick yet precise production of plans. The potential for such an interactive system, which we call "MacMapping," was demonstrated, although it awaits successful field trials.

In another aspect of the excavation, the video system did mesh well with more conventional recording techniques. The east wall of a transverse trench cut through the Highborn Cay ballast mound was filmed as the sampling of selected ballast stones proceeded. In conjunction with standard profile mapping techniques, the video documentation of the sampling provides location data on the chosen stones in relation to the entire profile.

Other innovations

A device for measuring the inclination of various *in-situ* timbers was developed by *Coral Reef II* Captain John Rothchild. Appropriately named the "Rothchild Quadrant," the device consisted of two aluminum bars joined at one end with a bolt and a thumbscrew. One bar had a bubble level attached to it, while the other bar was free to pivot so as to match the cant angle of one of the exposed timber faces. The resulting measured angle was scratched onto a recording board—in this case, a plastic mirror—which was fixed behind the two aluminum bars. Angular measurements derived by this method were quite dependable and corresponded nicely to the inclination determined from standard cross-sectional depth measurements.

Our experience at Highborn Cay demonstrated that, however carefully one plans the diving and research strategy of a project in advance, an indispensible component is the ability to innovate with existing resources and techniques, as local or immediate circumstances require.

September 10: As expected, the site is yielding few artifacts—mostly small, glazed and unglazed o.j. sherds, and a type of coarse, glazed redware which Roger says is unpublished. We've named it Highborn Red. Also a few lead fragments with holes—doubtless sheathing; some olive pits and other minor miscellany. The assemblage is fairly inelegant and uninformative. The original salvors obviously did their work well.

Lost Clues Recovered By Casting Concretions

By Bruce F. Thompson

The goal of an archaeologist is to reconstruct the culture and lifeways of people from a different time, and this role primarily is accomplished by recovering, recording and researching objects which past populations left behind. Artifacts provide tangible evidence of what people did and how they lived.

Artifacts retrieved from the sea can be especially informative, not only because they often are found in undisturbed and concentrated locations, but also because certain materials which will not survive on land sometimes are preserved in an aqueous environment. Unfortunately, in marine contexts, this is not precisely the case with items made of iron.

Once deposited on the seabed, an iron artifact goes through a process of chemical and physical change that often results in the total or near-total loss of all original metal. However, the artifact is not entirely lost because a hard, crusty shell, referred to as "encrustation," begins to adhere to the object almost immediately after it comes to rest on the sea floor. A perfect image of the artifact is mirrored at the interface between the original iron and the concreted sand, shell and calcarious encrustation. Using an epoxy tooling compound, a conservator can fill the cavity of a concretion, allow the compound to set, remove the encrustation, and expose a detailed representation, called a "cast," of the original iron object.

The process of casting an artifact, while not a complicated procedure, does require patience with every step. An object selected for casting is first drawn to scale in its concreted shape. Then, a line is etched around the concretion with a pneumatic chisel; once cut open, the cavities of the two halves are cleaned of iron residue. The sections then are rejoined, and a hole is cut at the join to enable the mold to be filled with Hysol ™, a two-part epoxy resin. Once the Hysol has set, the encrustation carefully is removed, revealing a near-perfect representation of an iron artifact which otherwise might have been lost to the archaeologist.

The shipwreck at Highborn Cay at one time contained many iron artifacts. When the site originally was salvaged, these were removed without proper recording techniques and without subsequent conservation, thereby rendering them useless for detailed study. However, photographs of the deteriorating objects and rough drawings of their positions on the seabed eventually were obtained by INA archaeologists. The positions and types of ordnance on the site, as well as the apparent chainplate and fastener types, attested to the similarity between this vessel and the Molasses Reef Wreck (MRW) in the Turks and Caicos Islands, which INA has excavated scientifically. Having recovered more than three thousand *in-situ* iron objects from the latter site—hundreds of which have been cast—we hope to extrapolate some of our findings from the MRW assemblage to our analysis of the Highborn Cay site. In this way, information from these two shipwrecks will enable us to visualize a moment in history, mirrored through artifactual proof.

Hysol epoxy is poured into an encrustation mold to create a replica of a lost artifact. (Photo: MRW project staff)

Artifacts Are Missing Elements Of The Wreck

By KC Smith

Despite stunning hull remains that offered the first substantive evidence of the construction of early 16th-century ships of discovery, the Highborn Cay Wreck yielded a scant selection of artifacts when INA investigated the site. We had expected as much, knowing that it previously had been salvaged. Moreover, we had not sought permission from the Bahamian government to retrieve artifacts, except as they could be examined and returned to the site during our stay.

Ironically, it was the nature and distribution of ordnance and hardware recorded and reported by the original salvors that first lured us to investigate the wreck. Many artifacts and their associations paralleled finds made at the Molasses Reef site. To establish these similarities, we attempted track both salvors and artifacts, and ultimately were able to sketch a rough picture of the ship's original complement of equipment, based on the discoverers' comments, a single published report, and examination of a few of the recovered objects.

Ordnance raised from the site in 1967 included two *bombardetas*—large wrought-iron, breech-loading cannons, and two compatible breech chambers, or quick-change powder charges. At least thirteen smaller wrought-iron swivel guns, called *versos,* and as many as eighteen *verso* breech chambers were retrieved, as well as iron wedges used to hold the chambers in place. In addition, numerous examples of iron-cored lead shot, and a unique barbed, wrought-iron harpoon with a two-meter-long shaft were found.

Three anchors were discovered by the salvors, one on the ballast mound and the others within 150 m of the mound. The largest, which may have been rigged as a bower anchor based on its position, was estimated to weigh 600-700 pounds; the smaller hooks weighed about 400 pounds.

Rigging components included three groups of chains with related elements from the standing rigging; a fragmentary sheave found in association with a fairlead and bits of line; and a bronze coak, or sleeve bearing. Numerous wrought-iron hull fasteners scattered across the site included forelock bolts with washers and small key-wedges, eyebolts, and square nails. At least three rudder pintles, one still attached to a gudgeon ring, lay adjacent to the ballast.

The discoverers reported few personal effects from the site, and no artifact which precisely dated the wreck. Three ceramic sherds and a reconstructed bowl, loaned by the Mariner's Museum and by one of the salvors, Robert Wilke—who also provided original notes, photographs and a film—were studied by INA Research Associate Roger Smith. The fragments, representing three different utilitarian vessels, were identified as *melado* ware, a lead-glazed earthenware found in the New World on pre-1550 hispanic sites. The *escudilla*-shaped bowl, reconstructed from original sherds and plaster, was made of unglazed earthenware.

A wide range of sherds found during the INA excavation further attested to the variety of containers carried aboard the vessel. Glazed and unglazed fragments of olive jars and other utilitarian wares were encountered, as well as numerous sherds of a previously undescribed, greenish-glazed redware, which was dubbed "Highborn Red."

Only a few iron objects were visible, concreted to the seabed near the ballast. Bits of lead sheathing that had encased the keel were found in the keel trough; other lead fragments were found in the transverse trench. A handful of seeds, probably olive pits, and three bones, apparently from small mammals, also were recovered from among the central timbers.

Vessel Construction...

Continued from Page 10

shape of the hull was negligible. Possibly, frames under unexcavated portions of the ballast could provide this much-needed information.

One unusual feature of the hull revealed by the site plan was the misalignment of the keel/keelson line between the exposed bow section and the midship trench. The ship apparently had "broken its back" at some point forward of the main mast after sinking.

Assessing the construction

The world has changed considerably since the day a small ship from halfway around the world found her last resting place off a lonely island in the Bahamas. One thing that is very different is the way in which ships are built. We have only a handful of ships that have been located and excavated and a few texts from the latter part of the 16th century which tell us something about earlier processes.

Ships of this period were not built from a set of plans since plans did not exist, but rather, from a mental template in the head of the shipwright, who based the dimensions of the ship on a set of proportions. These proportions, a different set for each ship type, were developed through years of trial and error during the lifetimes of many shipwrights—who passed their secrets on to their successors. The dimensions of a vessel would be formulated by relating the length of a timber or the distance between two points as a fractional equivalent of another, and all were based on the length of the keel. For example, the widest part of a ship, or the maximum beam, might be "a little less" than half the keel length; how much less was based on the experience of the shipwright.

The distance between the aft end of the trough and the forward tip of the keel on the Highborn Cay Wreck is 12.75 m. This provides a starting point for calculating the overall dimensions of the ship. From a late 16th-century text on navigation, we have learned the proportions for building a ship; using the length of keel from the Highborn Cay Wreck, we calculate the following dimensions: keel length, 12.75 m; beam, ca. 6.0 m; depth of hold, 4.25 m; and length overall, 19.12 m.

Whether these figures represent the actual dimensions of the Highborn Cay Wreck, we cannot be certain since we do not know whether the correct formula was used in the calculations. However, the sizes certainly provide a fair idea of the length and breadth of the vessel. Perhaps further study of the field information or further excavation of the site will provide the additional evidence needed to solve this puzzle.

INSTITUTE OF NAUTICAL ARCHAEOLOGY

P.O. Drawer AU, College Station, TX 77840 409/845-6694