The INA Quarterly

THE INA QUARTERLY

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On the cover: The telemotor, or mount for the wheel, of R.M.S. *Titanic*—standing on the bridge under over 3700 meters of seawater since April 15, 1912—was visited recently by INA Founder George F. Bass in the submersible *Mir 2*. Courtesy of National Oceanic and Atmospheric Administration (NOAA).

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The Institute of Nautical Archaeology is a non-profit scientific and educational organization, founded by George F. Bass, Michael Katzev, and Jack Kelly and 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 opinions expressed in *Quarterly* articles are those of the authors, and do not necessarily reflect the views of the Institute.

The *INA Quarterly* was formerly the *INA Newsletter* (vols. 1–18).

Editor: Christine A. Powell

Titanic 2003

George F. Bass

Courtesy of NOAA

I was surprised and more than a little nervous when I received, from Captain Craig McLean, Director of the National Oceanic and Atmospheric Administration's Office of Ocean Exploration, an invitation to dive on the *Titanic*. It would be fascinating to assist NOAA in assessing the great ship's state and rate of decay. However, the deepest I had ever been was three hundred feet (see "Yalikavak 1990," *INA Newsletter* 17.4, 18–21). *Titanic* lies two and a half miles–that's 12,460 feet!–beneath the North Atlantic. I was soon to learn that more people have been in outer space, indeed to the top of Mount Everest in one month, than have ever been to the *Titanic*. Nevertheless, with permission from the Turkish Ministry of Culture, I left the Pabuç Burnu excavation in the very capable hands of assistant director Mark Polzer and flew to Newfoundland.

Photo: L. Johnston

Fig. 1 *(above). A postcard of* Titanic *signed by members of the team.*
Fig. 2 *(below). Rusticles on* Titanic's *hull.*

With icebergs and whales visible in the distance, we sailed from St. John's on June 20, 2003, aboard the Russian R/V *Akademik Mstislav Keldysh*, the world's largest research ship. I represented INA among a seven-person team headed by NOAA marine archaeologist Jeremy Weirich (fig. 1). Others were National Park Service archaeologist Larry Murphy, whose continuing study of the battleship *Arizona* at Pearl Harbor has made him especially knowledgeable about the long-term stability of iron hulls, and Drs. Roy Cullimore and Lori Johnston, microbiologists who specialize in the study of the microbes that eat iron and form, at *Titanic*'s depth, huge brown things like stalactites that were dubbed "rusticles" by Robert Ballard when he located the wreck (fig. 2). Both Roy and Lori were returning to *Titanic*, Lori for her fifth visit. Rounding out the team were Laura Rear, Knauss Sea Grant Fellow at NOAA, who had taken care of the logistics of the mission, and Craig McLean, himself, whose impressive background includes not only degrees in zoology and law, but two years as a professional helmet diver.

Photo: Courtesy R/V *Keldysh*

Fig. 3. *R/V* Akademik Mstislav Keldysh *is the world's largest research ship.*

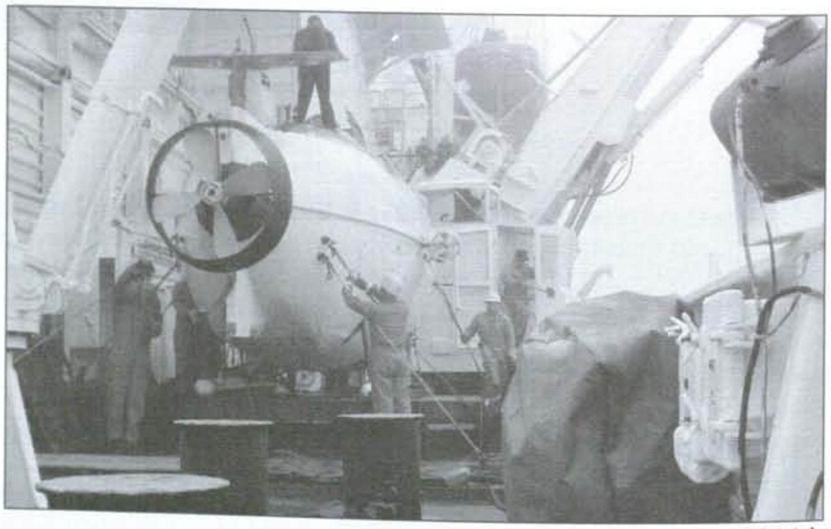


Photo: J. Weirich

Fig 4. *One of the* Mir *submersibles being prepared for launch from* Keldysh.

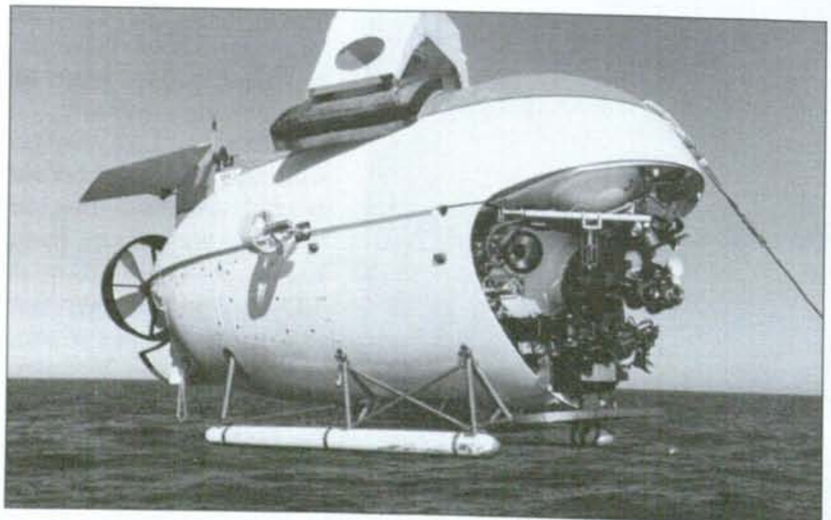


Photo: Courtesy R/V *Keldysh*

Fig. 5. *The* Mir *submersibles are two of only four vessels in the world capable of visiting* Titanic.

Photo: G.F. Bass

Photo: G.F. Bass

Fig. 6 *(left). Dr. Anatoly Sagalevitch in a casual moment.*

Fig 7 *(above). A "cowboy" leaps onto one of the submersibles to remove the lowering cable from* Keldysh *for a trip to* Titanic.

The *Keldysh* carries *Mir 1* and *Mir 2*, two of four submersibles in the world capable of diving as deep as *Titanic* (figs. 3 and 4). Each cost $20 million. They usually dive together, about an hour apart. No one said it explicitly, but I think part of the reason for this is safety, for one sub, with its manipulators, can help untangle the other should it become entrapped by cables or twisted metal. These were the subs James Cameron used in the films *Titanic*, and *Ghosts of the Abyss*, and which presumably he will use again (fig. 5). He was paying for much of our voyage in order that some of his team, on board with us, could dive on the actual *Titanic*.

Dr. Anatoly Sagalevitch is the driving force behind *Keldysh* and the *Mirs*. Since the collapse of the Soviet Union, under which all three vessels were built, he has had to depend on private sources to fund their operation–indeed, to fund all of the oceanographic research conducted from *Keldysh*. He thus often uses them for projects like the one I was on, or for filming, or even for taking paying passengers to *Titanic* for $36,000 a dive. I became highly impressed by Anatoly's entrepreneurship and his humanity (fig. 6).

On our first morning over the wreck, the crew of *Keldysh*, using GPS coordinates, dropped four transponders around *Titanic*. Every other day for the next ten days the *Mirs* would navigate within this "box" with seeming ease. I was scheduled to be on the last dive.

There were many books and videos about *Titanic* on board, so I spent the time before my dive becoming completely familiar with the story of the ship and what has happened to her since she was discovered. Weather for all ten days we were over the wreck was incredible, with little wind and only small waves (fig. 7). Early one morning I stood alone on deck, staring at the calm sea, thinking about the fact that one night in 1912, exactly at this place, over 1,500 people in life jackets were calling for help, drowning, or freezing to death.

On the day of my dive, June 29, I felt like an astronaut as I walked the corridor to the *Mir* laboratory in my blue, fireproof jump suit. I had taken pictures and videos of earlier launches and retrievals so was ready for my dive. Up the ladder, off with shoes, and down inside a steel sphere seven feet in diameter (fig. 8).

I was joined by Craig McLean, followed by Victor Nischcheta, our Russian pilot, who speaks little English. Then we were lifted up and out by a huge crane (we weighed 18 tons) and set in the water (fig. 9), where a Russian "cowboy" leapt from a Zodiac onto the top of the *Mir* to unhook us from the crane and hook us to a launch, the *Koresh* (slang for "comrade," meaning something like "Pal", I guess, in Russian), which towed us clear of the *Keldysh* (fig. 10).

We then began our two-and-a-half-hour descent. I was understandably excited when we passed 1,000 meters, but we eventually reached 4,790 meters. The incredible exterior lights then went on. Almost immediately I saw a large soup tureen, and then dozens or hundreds of wine bottles in the positions they had held in wooden cases nine decades ago, followed by a bathtub. I became more emotionally involved when I saw a woman's high-topped shoe lying alone on the seabed.

We in *Mir 2* then began, in sixteen controlled passes, a four-hour program of videotaping the badly mangled stern of *Titanic* for a photomosaic which should serve as a database against which future damage from age, visitors, and/or remotely operated salvage equipment can be measured. Kneeling before a central port about eight inches in diameter, Victor operated the *Mir* with intense concentration, often glancing quickly at an internal compass to be sure we were on line (fig. 11). Craig, using coordinates from the invisible transponder "box" in which we operated, guided Victor to the starting point for each of the sixteen parallel passes, and then, reading from a digital monitor, recorded on paper at timed intervals our exact position. Similarly, so that Victor would not be distracted by keeping track of too many gauges, Craig routinely read aloud our depth from another monitor, letting us know that we were staying at exactly

Photo: L. Murphy

Fig. 8 *(top right). Dr. Bass boarding* Mir 2 *for his trip to* Titanic.

Fig. 9 *(below). The submersible being lowered from the deck into the sea.*

Fig. 10 *(right). A "cowboy" riding* Mir *while it is towed clear of* Keldysh.

Photo:D. Concannon

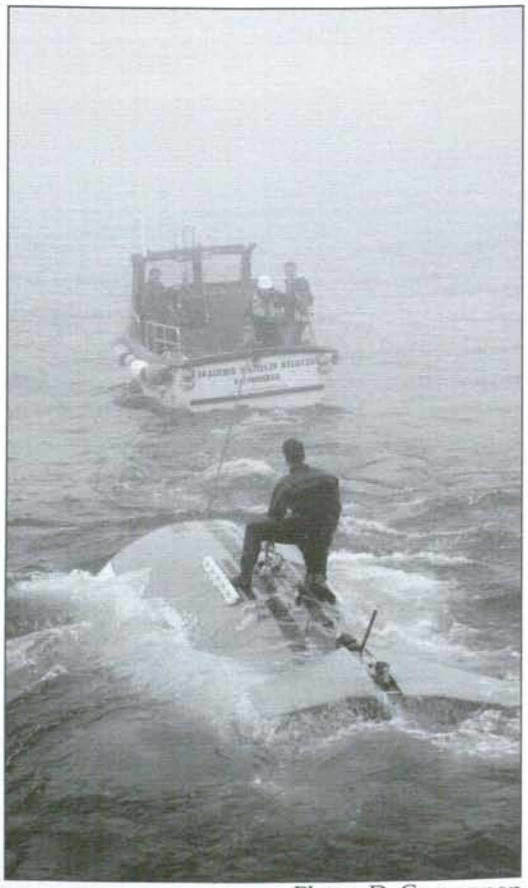


Photo: D. Concannon

Photo: G.F. Bass

Fig. 11 *(left). Victor Nischcheta checking the instruments on* Mir 2.

Fig. 12 *(below).* Titanic's *bow railing seen through a* Mir *viewport*

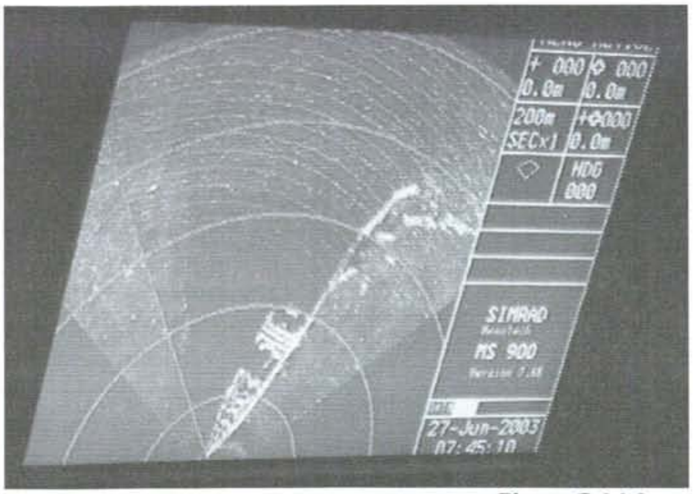


Photo: C. McLean

Photo: G.F. Bass

Fig. 13 *(above). A sonar image of* Titanic's *bow.*

Fig. 14 *(right). Roy Cullimore studies* Titanic *rusticles through his viewport.*

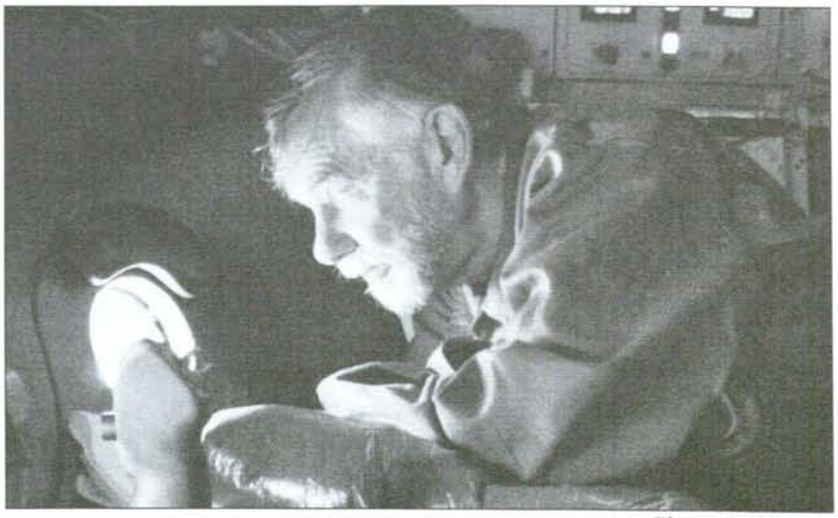


Photo: J. Weirich

Photo: G.F. Bass

Fig. 15. *The brass mounting for* Titanic's *wheel.*

Photo: G.F. Bass

Fig. 16. Titanic's *side, as seen from the submersible.*

3,783 meters. Sometimes I spelled Craig by reading our depth aloud. At other times I lay on my stomach on my bench, following our progress and occasionally photographing through my smaller, starboard port. My view was partly blocked by the *Mir*'s externally mounted cameras and lights (fig. 12), however, so I sometimes lay on my back in order to watch incredibly clear images of the wreckage on a Sony video monitor mounted in the stern of the cabin.

I was never nervous. Time flew. When we moved toward *Titanic*'s bow (fig. 13), Victor pointed to *Mir 1*'s lights as the other sub passed us, taking our place at the stern. Traffic two and a half miles beneath the sea! Lori Johnston and Jeremy Weirich were in the other sub, which had preceded us down by about an hour, piloted by Anatoly Sagalevitch.

The debris field of several hundred meters between the stern and the bow of *Titanic*, which broke in

Photo: C. McLean

Fig. 17. *The crew of* Mir 2 *eats lunch two miles deep in the North Atlantic.*

two as she sank, has been legally picked over by the salvors, RMST Inc., which raised several thousand artifacts that have been seen by millions of people and are now on display in England. Still, many plates and other objects remain in this area. The salvors are forbidden by law to sell anything, I am told, or to take anything from inside the ship, itself.

Then we arrived at the bow, which is magnificent, stunning—and unimaginably huge (Rose and Jack no longer stood there!). It was impossible to look on without becoming pensive about the tragedy enacted here (fig. 14). We saw the mast from which the fatal iceberg had been spotted, and the brass mounting for the ship's wooden wheel (fig. 15, cover). But we did not linger. There was work to be done. We began to make a video mosaic of the starboard side of this section of the wreck, often in a controlled drift aft from the bow in the current (fig. 16). The lights of the submersible were so bright I could see from the top of the ship to the seabed many feet below, where the bow had dug into the sediment to a depth of fifty feet. Most of the portholes still have their glass in place. Several were open, as if someone had just looked outside to see what was happening ninety years before.

I could not resist: I had taken down from the ship's library a paperback copy of Clive Cussler's *Raise the Titanic*, and spent a few seconds posed as if reading it with *Titanic*'s hull just outside the *Mir*'s starboard port behind my shoulder. I hope that Clive, who has made his own mark in underwater archaeology, gets a kick out of the photo.

At that depth, the pressure is three tons per square inch. Like most of the others, I put a few Styrofoam cups on the outside of one of the *Mirs*, one cup inscribed to INA in College Station. Crushed hard and now scarcely larger than a thimble, it sits on a shelf in Donny Hamilton's office as a souvenir of INA's deepest dive.

Six hours on the bottom passed like minutes. Victor had provided sandwiches for lunch on the way down (fig. 17). Now, as we started up, he offered hot tea and biscuits. Later, in various positions, the three of us used the large plastic bottles that were under Craig's seat for their special purpose.

We came up after dark in a dense fog. After eleven hours in the *Mir*, we flopped around for about half an hour more before we felt that we were under tow by *Koresh* back to *Keldysh*. Then it was back up onto the deck (fig. 18), and hugs all around (especially from Anatoly, who had preceded us up in *Mir 1*), followed by dinner that had been saved for Craig and me in the dining room. With most of the NOAA team around us, we made a toast with Russian vodka to our successful dives.

Then two full days back to St. Pierre (how many people know that there are two tiny, tiny French islands only a few miles south of Newfoundland), an overnight, and then back to St. John's by a small charter jet. It was quite an adventure.

On our way back from Turkey in August, Ann and I visited Ireland, where we visited Cobh, *Titanic*'s last port of call–then called Queenstown–on her only, tragic voyage. In just one summer I had seen the beginning and end of one of the most famous voyages in history.

Photo: J. Weirich

Fig. 18. *Dr. Bass's* Mir *dive lasted eleven hours and ended after dark.*

Post-Excavation Techniques for Recording Ship Timbers

Starr Cox and Katie Custer

The 2001 and 2002 field seasons in Lisbon, Portugal, have provided invaluable research opportunities to graduate students in the Nautical Archaeology Program (NAP) and the Institute of Nautical Archaeology (INA) at Texas A&M University, thanks to the initiative of Dr. Filipe Castro and the support of Dr. Kevin Crisman. Through the Centro Nacional de Arqueologia Náutica e Subaquática (CNANS), created in 1997 as a division of the Instituto Português de Arqueologia (IPA), students were able to work with and learn from the premier Portuguese underwater archaeologists. Under the guidance of Francisco Alves, director of CNANS, and Paulo Jorge Rodrigues, principal investigator of the Cais do Sodré wreck, the team gained experience in recording dehydrated ship timbers post-excavation.

The wreck, dating to the fifteenth or sixteenth century, was uncovered in Lisbon's Cais do Sodré subway station in 1995. It is presumed to belong to the Iberian shipbuilding tradition and is probably Portuguese. According to a personal communication from Paulo Jorge Rodrigues, the tentative identification of nationality was based on construction details, while the age was determined by carbon dating wood samples. Some construction features suggest a later date than the initial fifteenth-century estimates. Therefore, the carbon dating is currently being repeated. Two new laboratories will test two new sets of wood samples that reflect these construction features. Considering the relatively limited knowledge of Iberian ships from the Age of Discovery, the recovery of a well-preserved ship from this period is of considerable importance and an exciting prospect for the researchers involved.

The 2001 team of INA/NAP students included Katie Custer, P. Erik Flynn, Gustavo Garcia, Erika Laanela, Anthony G. Randolph, and Carrie Sowden. The main directive was to record the frames from the Cais do Sodré wreck. Due to the muddy, landlocked conditions under which the ship was excavated and the lack of suitable storage facilities at the time of the excavation, it was decided to keep the timbers in dry storage. CNANS inherited the timbers in a dehydrated state. This created challenges for the team recording and reconstructing the ship due to problems of shrinkage and distortion. In an attempt to counter these problems, the timbers were placed in a storage tank of fresh water to rehydrate before documentation. The rehydration of the timbers, however, could not completely restore the original state of the frames.

Using a forklift, the frames were transported onto a custom-designed table for recording. An accurate grid was permanently engraved into the plexiglass that covered the length of the table. Once the frame was situated and aligned on the grid, the recording process began. The main constructional details recorded were general dimensions, fastener holes, dovetail scarfs, tool marks, and carved numbers indicating predesigned frames. The fastener holes measured one to three centimeters in diameter, and the openings were square or round in shape. The futtocks were attached to the frames by dovetail joints, which were found on most of the complete timbers. Tool marks left by the original shipbuilders included saw marks and divots created by chisels. The predetermined frames were numbered with Roman numerals I–XVIII on their design faces. As common in the Iberian shipbuilding tradition, the design faces are those which face the master frame. In other words, the numbers were engraved on the forward faces of the after frames, and the after faces of the forward frames.

The keel and keelson faces of each timber were drawn at 1:10 scale using the scaled plexiglass, plastic triangles, and metric rulers. Offsets were taken every ten cen-

Photo: F. Castro

Fig. 1. *P. Erik Flynn takes measurements for a 1:10 scale perspective drawing of the keelson face.*

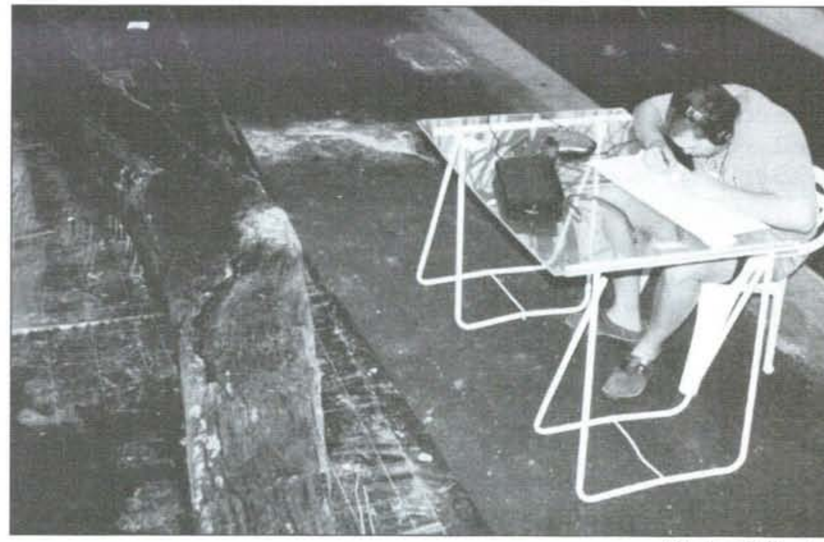


Fig. 2. *Anthony Randolph makes final touches on a 1:10 scale perspective drawing of a keel face.*

Photo: F. Castro

timeters to obtain the overall shape and size of the frame, creating a perspective drawing (fig. 1). Detailed features were then recorded (fig. 2). In addition to the 1:10 scale drawings, 1:1 scale drawings of these faces were created by attaching plastic film directly to the frame and outlining the features. The forward and aft faces were also recorded at 1:1 scale, but using different techniques. A plexiglass table was built (without the grid) that stood roughly two feet above the ground. Plastic film was attached to the surface of the table and the table was placed over the timber lengthwise (fig. 3).

Using a device incorporating an indelible pen and a laser pointer, the shape of the timber was traced onto the plastic film (fig. 4). The pen was housed in a block of wood with a lip in which the laser pointer was situated. The pen was aligned to accurately mark the spot created by the laser pointer on the table. The laser was then used to trace the timber and its features. This device saves valuable time and helps diminish parallax errors. It also permits one to draw a continuous line around the timber while being assured that the representation is accurate in spite of the height of the table. This process allowed for the expedient documentation of the frames.

The 2002 team comprised NAP students Starr Cox, Katie Custer, P. Erik Flynn, Gustavo Garcia, and Sara Hoskins. The primary goal for the 2002 season was to complete the 1:10 drawings of the forward and aft faces from the 1:1 drawings completed the previous season. Upon completion, all drawings, including the 1:10 upper and lower face drawings from the previous season, were dou-

Photo: F. Castro

Fig. 3. *Paulo Jorge Rodrigues and Carrie Sowden gather materials needed to record the ship timbers.*

Fig. 4. *Gustavo Garcia uses the pen and laser device to trace the surface of a timber.*

Photo: F. Castro

ble-checked against the actual timbers. Lastly, the drawings were given to Dr. Filipe Castro who produced the final inked versions. In conjunction with the drawings of the forward and aft faces, a photographic record of all carpenters' marks was prepared.

The recording of the forward and aft faces was completed using the same basic methodology as the previous year, but with slightly different techniques. The 1:10 perspective drawings of the upper and lower faces had to be drawn viewing the actual timber. The objective of the 2002 season was to produce a set of scaled-down drawings of the forward and aft faces using the previous 1:1 drawings made in 2001. This helped to limit the amount of damage to the frames from handling and drying out. Information is lost each time the timber is exposed to a different environment, as well as through the stress of transportation. The 1:1 drawings prepared on plastic film were laid out on the same plexiglass grids used earlier, and using a triangle, measurements were taken every ten centimeters (fig. 5). These were then plotted onto millimetric grid paper (fig. 6). If we had been back in College Station, we would have digitized the 1:1 drawings on a digitizing table directly into AutoCAD®. We could then have printed them out at any scale we desired.

Checking the drawings against the timbers proved to be highly rewarding. A year's worth of submersion in fresh water resulted in a cleansing of the timbers, and new features were uncovered, including additional carpenters' marks and nail holes. Also, there were only a few minor discrepancies between all the drawings and all the timbers, which gave everyone the satisfaction of a job well done.

Photo: F. Castro

Fig. 5. *Sara Hoskins lines up an existing 1:1 scale drawing on a grid in preparation for reducing the drawing to 1:10 scale.*

Overall, the project was successfully completed due to the contributions of the INA and CNANS teams. The guidance provided by Francisco Alves and Paulo Jorge Rodrigues gave the INA students the tools and support needed to accomplish the project goals, as well as, valuable skills that can be utilized on future projects. Given the time constraints imposed on each field season, the drawings were completed in the best possible sequence. The 1:1 drawings serve as a permanent record of the timbers and their features, while the 1:10 drawings function as working copies for analysis. Rechecking the drawings against the actual timber after a long period of wet storage proved to be very valuable in exposing new information. The process of recording dehydrated timbers post-excavation was constructive to both the students and the researchers. The condition of the wreck and the problems inherent in the excavation led to a unique set of circumstances, as with all archaeological studies of shipwrecks. These proved to be an important learning tool. The experience gained will help all parties in future excavations involving landlocked nautical sites.

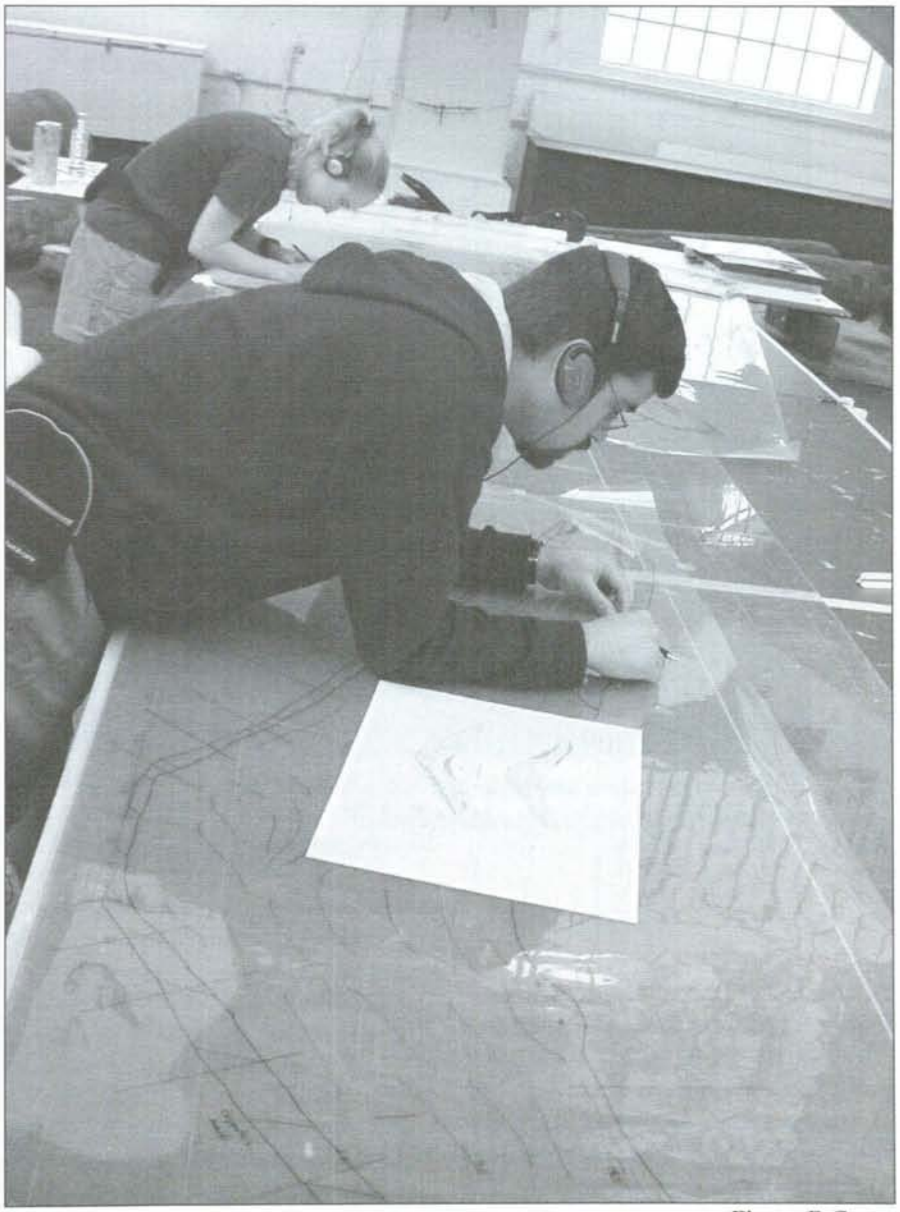


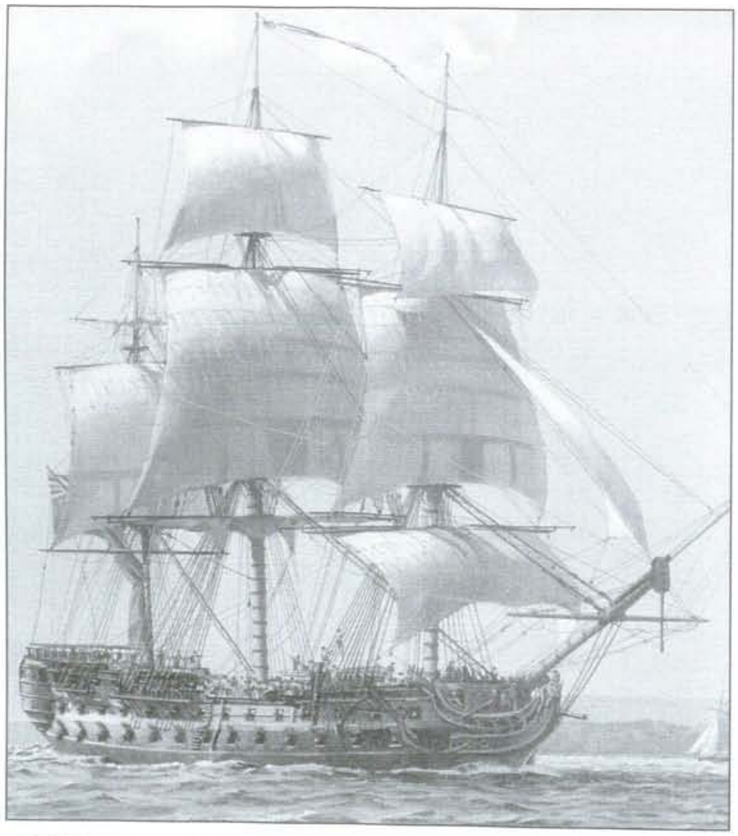
Photo: F. Castro

Fig. 6. *Starr Cox and Gustavo Garcia create 1:10 scale drawings from existing 1:1 scale drawing.*

A Witness of Trafalgar: The Cannon of the H.M.S. *Agamemnon*

Atilio Nasti, Scientific Director, and Hector Bado, Director of Operations,

Maldonado Bay Underwater Archaeological Project



" Without exception, one of the best Sixty-fours in service, with the particularity of navigating extremely well"

Captain Horatio Nelson

For many years, the exact place where Admiral Lord Nelson's favorite ship–the famous H.M.S. *Agamemnon*—had sunk was uncertain. Documents located it near the coast of the Bay of Maldonado in Uruguay, but its exact position was forgotten. A stroke of luck enabled Hector Bado and Sergio Pronczuk, two professional divers and historians, to find the remains of a shipwreck three hundred meters to the east of the place where *Agamemnon* was believed to have sunk on June 16, 1809. The location of several dozen copper objects, parts of the bilge pumps with the "broad arrow" symbol of the British Navy stamped on them, confirmed the discovery. Since the shipwreck was rediscovered in 1993, it has been surveyed and many artifacts recovered. Mensun Bound of Oxford University has made a complete plan.

Among the recovered objects was a twenty-four-pounder iron cannon. This is one of the most important items found in the shipwreck. The cannon is 3.10 m long and weighs 2450 kilograms (fig. 1). A crown and the monogram of George III are clearly seen on the surface. The gun number "20" and the broad arrow are also visible. As far as we know, this is the only surviving British cannon that was actually used at the Battle of Trafalgar.

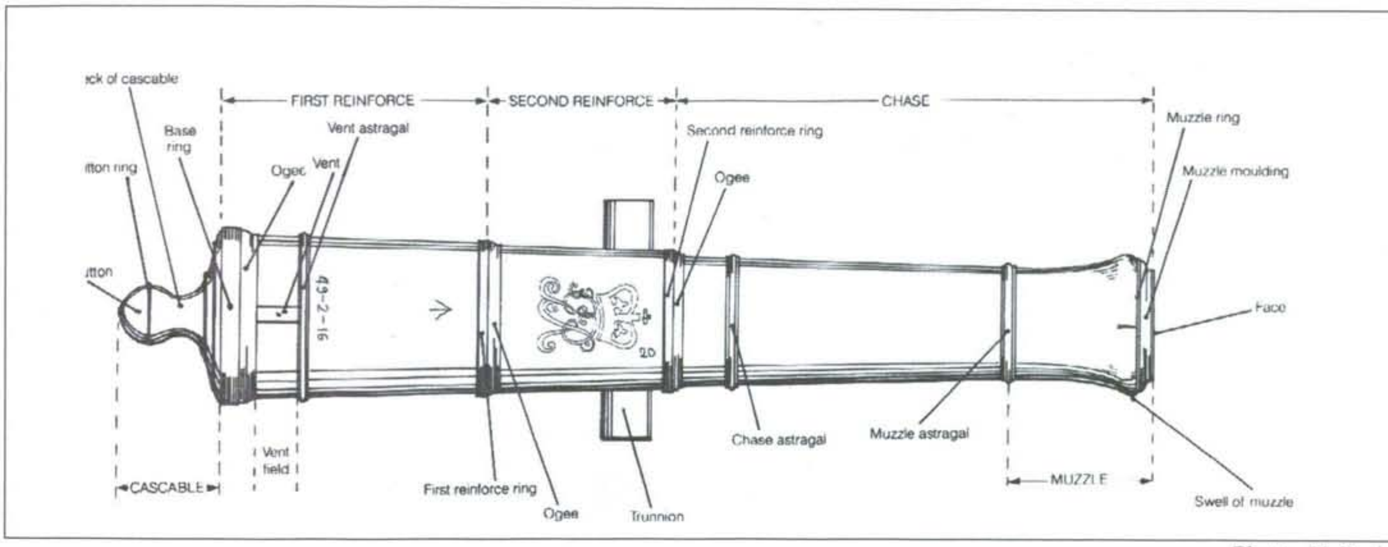


Fig. 1. *The twenty-four pounder cannon recovered from the wreck of H.M.S.* Agamemnon.

Photo: H. Bado

Fig. 2. *(right) The 1804 ordnance list from* Agamemnon.

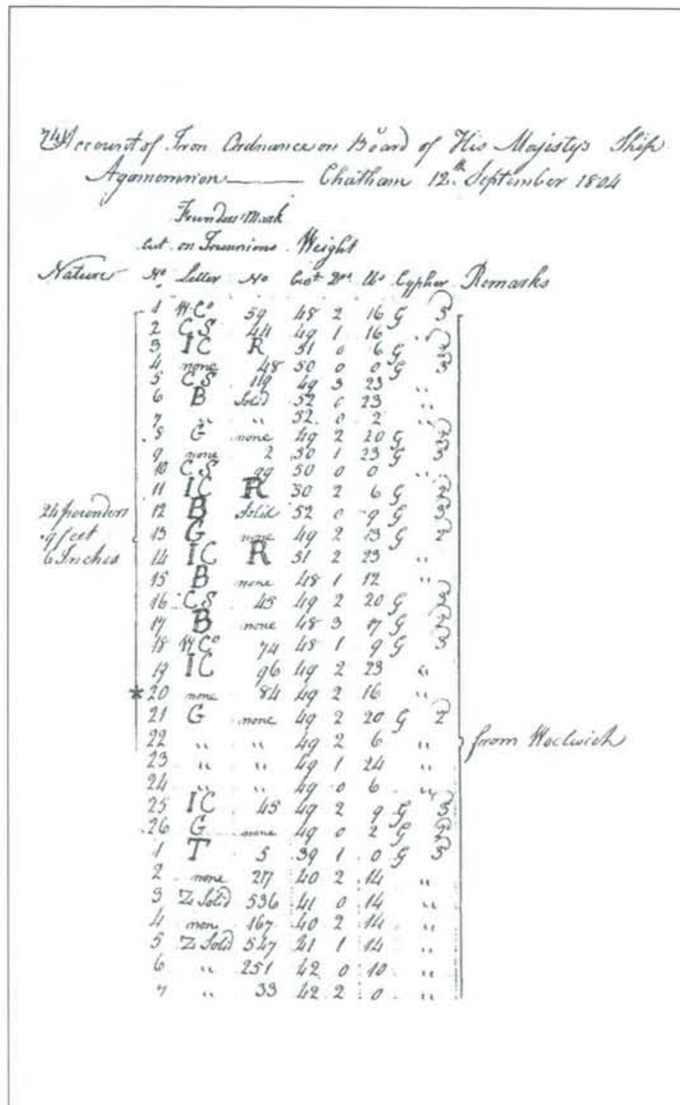


Photo: Her Majesty's Public Record Office, London

H.M.S. *Agamemnon*

The warship H.M.S. *Agamemnon* was built in 1777 at Buckler´s Hard shipyard near Portsmouth. Built under the direction of Henry Adams in accordance with the plans of the memorable naval designer Sir Thomas Slade, *Agamemnon* belonged to the "*Ardent*" class, whose plans are kept in the National Maritime Museum in Greenwich. It was the third in a series of seven sister ships. Copies of the plans are exhibited in the Marine Museum of Buckler's Hard in Beaulieu, as well as in the National Historical Museum and the National Marine Museum of Montevideo.

Agamemnon displaced 1384 tons, and was 49 meters long, with 13.5 m beam, and 6.5 m draft. The ship carried sixty-four guns and was known as a "third rate," in accordance with an order of the Admiralty in 1653, because of the position that it occupied in the line of battle. According to the ordnance manifest, H.M.S. *Agamemnon* had the following armament:

Main deck, 26 24-pounder guns
Upper deck, 26 18-pounder guns
Maincastle, 10 9-pounder guns.
Forecastle, 2 9-pounder guns.
Total guns, 64.
Total carronades, 12 24-pounders
Total armament weight, 144.5 tons.

Photo: H. Bado

Fig. 3. *The conserved* Agamemnon *twenty-four pound cannon.*

The original *Agamemnon* ordnance list from September 1804 (fig. 2), before Trafalgar, clearly includes cannon number 20.

Agamemenon participated in numerous battles, from Ushant in 1781 until the blockade of Lisbon in 1807. Captain Horatio Nelson commanded *Agamemnon* from 1793 to 1796. He considered the warship to be "without exception, the best Sixty-four in service." At Trafalgar (October 21, 1805), Sir Edward Berry commanded the ship. In 1808, *Agamemnon* was dispatched to be part of the Royal Navy's South American squadron based in Rio de Janeiro. After an initial visit to the Rio de la Plata that year, the ship returned in June 1809.

Inadequate maintenance for tropical conditions weakened the hull and *Agamemnon* sank north of Gorriti Island in Maldonado Bay on June 16. Two days later, Captain Jonas Rose was ordered to recover what could be salvaged. When this operation finished in November 1809, the ship was abandoned.

Treatment of the Cannon

Because of its unique significance as a Trafalgar survivor from Nelson's favorite command, preservation of the *Agamemnon* cannon was imperative. It was found at a depth of 8.5 m. At the suggestion of expert conservators, the gun was transferred to the port of Punta del Este and left in two m of water to begin decompression. After three months, personnel of the Naval National Prefecture transferred it to a facility in the Port of Montevideo.

When deposited on the sea bottom, a ferrous metal artifact is quickly colonized by marine organisms that build a compound external skeleton. This concretion forms a barrier between the iron metal and the environment that surrounds it, creating a micro-environment that stabilizes the corrosion. This phenomenon appears to remain constant with time across a variety of environments and geographic locations.

Chlorine ions that diffuse into the metal from the salt-water environment greatly accelerate corrosion once the artifact is exposed to atmospheric oxygen. Therefore, the biggest task in stabilizing iron artifacts is to stop this natural process of corrosion by removing the chlorine. The electrolysis process used by most conservation laboratories uses an electric current to reduce the iron oxide FeO(OH) to Fe^3O^4, and draws the negatively charged chlorine ions out of the metal.

In a first treatment stage, the marine concretions were mechanically removed. This allowed the electrolysis process to act on the original surface in order to reach the iron body. The cannon was then deposited in the center of a steel tank for electrolysis treatment with enough space for the anodes (positive electrodes) to be placed at a distance that did not exceed twenty cm from the border of the tank. It was then filled with a solution of distilled water and sodium hydroxide (NaOH) at a five percent concentration. The electrodes (the anodes and the cannon itself as the cathode) were fed with a four-volt DC power source at an average of 0.005 amp/cm.

This electrolysis process was applied for almost forty-eight months, alternating with rest periods. Intermittent application of the voltage helped control the evolution of gases and avoided the possible damage to small details on the original surface of the cannon. Regular monitoring of the chlorine content in the solution showed when the solution needed to be changed.

Treatment of the bore began during November and December of 2001. A drill was custom built with the appropriate diameter to clear out the concretion, then cleaning was completed by electrolysis. Conservation was completed when the last eighty cm of the bore had been cleaned.

After removal from the electrolysis tank and rinsing, the cannon was brushed with non-abrasive tools and dried with several baths of acetone, then placed in an environment with a temperature of forty degrees Celsius for twenty-four hours in order to evaporate the acetone remains. Finally, the gun was coated with two layers of polyurethane protectant (figs 3 and 4).

Although we could have opted for a shorter-term treatment by using chemical cleaning, this could have created an unnecessary risk to a unique artifact. Therefore, the H.M.S. *Agamemnon* cannon was conserved using the standard protocol for stabilizing cast iron marine artifacts. As is wise with all cast iron artifacts, the cannon is stored in a dry atmosphere, where the weather cannot affect it. It will be monitored periodically to check for any alteration of its surface. As part of the regular maintenance of the artifact, the curators will regularly check its stability, so that they can detect and treat any initial points of corrosion.

Photo: H. Bado

Fig. 4. *Detail of the markings on the* Agamemnon *cannon.*

Suggested Reading

Deane, A.
1998 *Agamemnon, La pasion guerrera de Lord Nelson*. Ed. Aguilar

Hamilton, D.
1997 *Basic Methods of Conserving Underwater Archaeological Materials Culturals*. Nautical Archaeological Program. Department of Anthropology Texas A&M University.

Lezama, A.
1987 Proyecto de rescate del pecio del navio "*Agamemnon*." (In preparation).

Nasti, A.
2001 *HMS Agamemnon*. www.subarch.com

Denbigh Exhibit Opens in Galveston

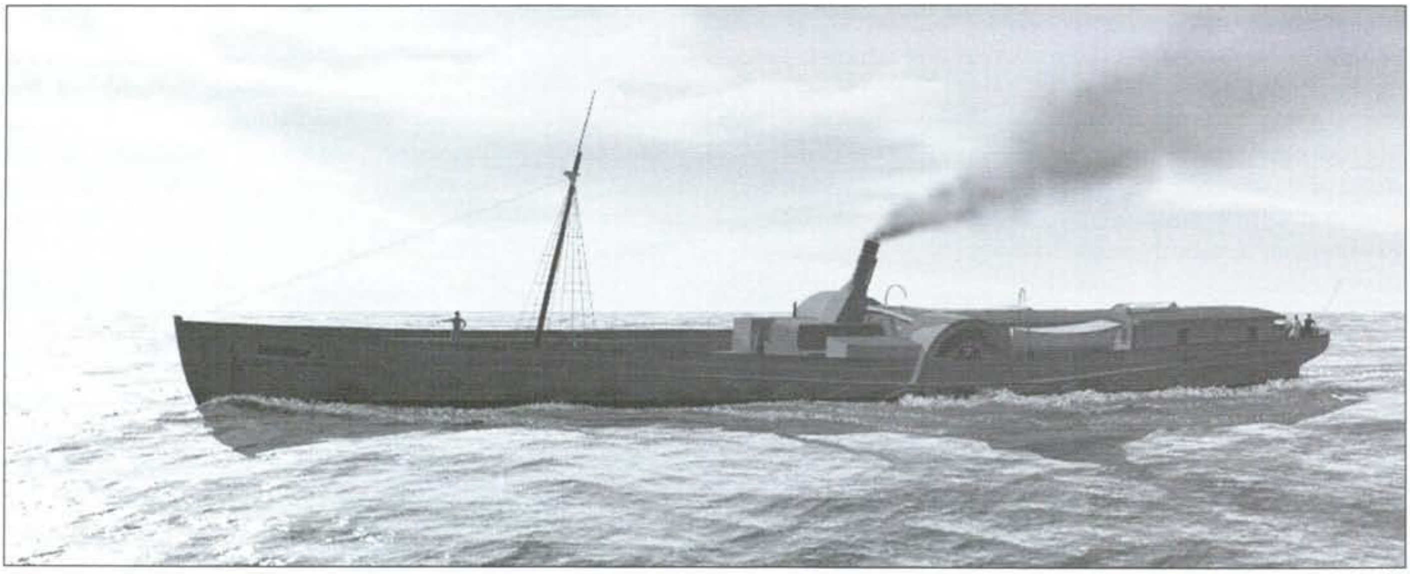


Image: A. Hall

The INA exploration of the Confederate blockade runner *Denbigh* (*INA Quarterly* 26.2, 3–12) has, from the first, contained an important public education component. This was most recently shown through an exhibit at the Galveston County Historical Museum that opened during the popular ArtWalk on Saturday, October 25, 2003, and will run until April 17, 2004. As was pointed out by Museum Director Christy Carl, the exhibit expresses the close historical connection between Galveston and *Denbigh*, which made six successful runs into the port before running aground on May 23, 1865, the eve of the fall of the city to Union forces.

Denbigh's repeated voyages from Cuba, first to Mobile and later to Galveston, made it among the most successful of all the ships that supplied the Confederacy with essential supplies. The shipwreck site on Bird Key, a shoal near the southern tip of the Bolivar Peninsula, was almost forgotten until the INA survey and excavation began in 1997. Many of the most interesting finds were installed in the Museum between October 13 and the opening. There are three parts to the exhibit. Two galleries of the south section of the Museum are devoted to the *Denbigh* artifacts, the west section has an exhibit on nautical archaeology and the *Denbigh* Project, while the east section houses a display on Galveston and the nation in the Civil War period.

The connecting rod that transmitted energy from one of the engines to its paddlewheel is among the largest items on display. Others include the *Denbigh* doll (*INA Quarterly* 29.1, 33), pottery sherds and other ceramics, a lead pig, spoons, a coconut shell and conch shell, spoons, wine bottles, and a single enigmatic rose stem. Among the other items on display are registration and builder's papers, cargo manifests, *Denbigh's* schedule, Civil War newspapers, a diver's suit, and a personal computer with an educational program. The exhibit contains discussions of the history of Galveston in the Civil War period, with its important role as a port for blockade runners, placing the runners in context as the lifeline of the Confederacy. The design and engineering of *Denbigh*, as reflected in both historical records and the archaeological remains, forms another important subject of the exhibit. A final focus is the archaeological work that has restored the history of *Denbigh* to its proper visibility in the historical record.

Acknowledgments: The *Denbigh* wreck is now in the custody of the Texas Historical Commission, which assisted INA archaeologists in the preparation of the exhibit. The newspapers are on loan from Lew Fincher and Andy Hall. The Galveston County Historical Museum, located at 2219 Market Street, is a joint project of Galveston County Commissioners Court and Galveston Historical Foundation. For further information, call Christy Carl at (409) 766-2340 or christy.carl@galvestonhistory.org.

IN MEMORIAM

Mendel L. Peterson
1918 – 2003

The pioneer underwater archaeologist Mendel L. Peterson, 85, died July 30 at his home in McLean, Virginia. He was best known for his work at the Smithsonian Institution from 1948 to 1973. He served there as Curator of the Division of Historic Archaeology, Head Curator and Chairman of the Department of Armed Forces History, and Curator of the Department of History, among other positions.

For twenty-five summers, beginning in the late 1950s, Mr. Peterson was personally involved in underwater archeological surveys and excavations around Bermuda, the West Indies, the Caribbean, and the Florida Straits. George Bass asked him to write the chapter on "Traders and Privateers across the Atlantic: 1492–1733" for *A History of Seafaring*, published in 1972. Most of what was known on the subject at the time is compressed into eleven pages. As Dr. Bass recently remarked, it is amazing how much more archaeologists and historians know now. In large part, the discipline owes much of its current knowledge to the impetus Mendel Peterson gave to New World nautical archaeology.

He was the first to identify a shipwreck discovered off the coast of Bermuda in 1956 as *San Pedro*, a Spanish merchant ship that sank while returning from Mexico in 1596. He was also involved in the exploration of *San Antonio*, a four-hundred-ton ship that ran onto a reef in 1621 while on the same route, and several other Bermuda wrecks. Mr. Peterson was instrumental in the Highborn Key excavation in the Bahamas sponsored by the National Geographic Society.

Mendel Peterson always sought to disillusion potential treasure hunters. "If a wreck is in shallow water," he said in 1958, "the chances of treasure on it are practically nil. … The Spaniards almost always knew where the ships sank, and they had native divers salvage the gold and silver." He recognized that the real treasures on most shipwrecks were the everyday objects that could provide a precisely dated cross-section of contemporary material culture.

Mendel Peterson had an unlikely start for a nautical archaeologist. After receiving a master's degree in English from Vanderbilt University, he served as an educational adviser to the Civilian Conservation Corps until he enlisted in the Navy in 1943. His official duties were as a supply officer. After the war, he studied textile engineering in a naval graduate school, and then designed and tested foul weather gear in Antarctica and on an icebreaker. However, during the war he had laid the groundwork for his future career by diving on wrecks in the Pacific Theater. Those initial dives with old Navy equipment led him to apply for his first position with the Smithsonian.

Besides his fieldwork and his curation tasks at the Institution, Mr. Peterson conducted extensive research in the archives and collections of America and the former colonial powers. This led to numerous articles in *National Geographic* and other publications, as well as two books, *History under the Sea* and *Funnel of Gold*. With two colleagues in 1958, he traced the course of the first voyage to America of Christopher Columbus, concluding that the first landing was in the Caicos Islands, not on the island two hundred miles to the west that is now called San Salvador, which is generally considered to be the landing site.

After his retirement from the Smithsonian, Mr. Peterson continued an active career as a consultant and lecturer. In 1994, he identified the resting place of USS *Kearsarge*, which sank the Confederate raider *Alabama* in 1864 and later wrecked on a reef east of Nicaragua.

Mr. Peterson is survived by his wife, Gertrude Auvil Peterson of McLean, Virginia, and three children: Victoria Peterson-Weitzel of Laurel, Virginia, LaNelle Spencer of Jackson, Wyoming, and Mendel L. Peterson Jr. of Salt Lake City.

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