Queen Anne's Revenge

Conservation Laboratory Report, December 2010

UAB Conservation Laboratory, Greenville
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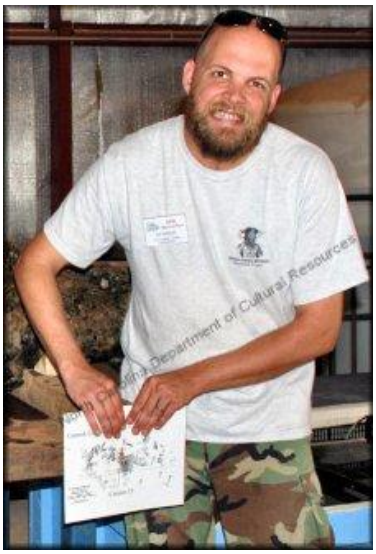
Throughout the spring and summer the *QAR* lab has been full of activity and expects a busy fall as funding for a field season means that new artifacts will be arriving at the lab. We have been fortunate to welcome new crew members; however we have also had some members of the team move on. Conservators are continuing to process artifacts and all the while learning new techniques to aid in the conservation process. ECU, *QAR* lab and Colonial Williamsburg Foundation hosted an international conference where conservation professionals from around the world had a chance to visit and share their knowledge of waterlogged organic archaeological material. ECU classes continue to tour the lab facility and lab staff seize every opportunity to participate in educating the public about the project.

Lab Crew Spring and Summer 2010



Our fall lab crew continued through the 2010 spring with Myron Rolston, Jon Schleier and Lauren McMillan returning. They contributed in various ways to artifact solution testing, documentation of finished artifacts, x-raying concretions, image processing, cannon treatments, wood treatments, assisting with visitor tours, and cleaning artifacts from concretion. Myron is always stretched in different directions as he helps with everything we do at the lab while concentrating on processing the lead shot. We are pleased to welcome Myron back this fall. Jon's main task was to remove ceramics and glass from concretion so these artifacts could start desalination. Jon completed his time in April and managed to remove approximately 70 objects from concretion. Lauren was assigned cleaning pewter flatware and completed numerous pewter plate fragments and 2 plates. Lauren finished her Anthropology masters degree in May and is currently pursuing her PhD in Anthropology at the University of Tennessee at Knoxville. The*QAR* lab staff said goodbye to Jon and Lauren at end of the semester, thanked them for their dedicated help and wished them the best.

Terry Williams started as a volunteer in February and then became a temporary employee from March to May. Terry is retired from the Air Force and has a BA honors in conservation from the City and Guilds of London Arts School with experience in object conservation. Terry was given a variety of tasks including data entry of XRF data, solution testing, digital image cleaning and cleaning artifacts from concretion thus being introduced to the various aspects of underwater archaeological conservation during her time at the lab. Williams is currently the director of the Wayne County Museum in Goldsboro and continues to volunteer for

the project one day a week. The *QAR* staff appreciates the time she spends at the lab.

Summer Volunteers

Two students volunteered during the month of June to gain more experience in the field of conservation. Catheryn Trew, an undergraduate student in the ECU Public History program, was introduced to our lab by participating in a class tour. Hannah Smith is a recent graduate from Bucknell University in Pennsylvania where she obtained a BA in Art/Art History and German is looking to attend a school focusing on conservation. They were given a variety of tasks including solution testing, topping up solutions, making desalination net bags, x-ray film inventory, cleaning copper alloys, entering XRF data, and cleaning images. Catheryn and Hannah were a great help and expressed interest in continuing to volunteer as their future schedules allow.

We would like to express our appreciation for our temporary and volunteer staff as we would not be able to accomplish the amount of work that we do without them. Thank you for all your hard work!

Freeze Drying *QAR* Frames and Other Small Wood Artifacts

Freeze-drying is sublimation under a low pressure vacuum at extremely low temperatures. Sublimation is the change from a solid (frozen) state into a gaseous state without going through the liquid phase. For archaeological waterlogged wood, freeze-drying allows water to be removed through sublimation while leaving the bulking agent PEG (polyethylene glycol) in the wood for structural stability. The final stage of conserving the *QAR* frames is the freeze-drying process. As mentioned in the April 2009 conservation report, the frames began the second stage of the PEG conservation process. Over the past 19 months, PEG 4000 was slowly added to the solution until it reached a PEG concentration of 20% PEG 400 and 23% PEG 4000 v/v solution. This final percentage concentration was determined with calculations involving moisture content, wood type and condition. After this percentage was reached the frames were ready for the next and final stage, freeze-drying. Without a freeze-dryer large, lab staff turned to the Maryland Archaeological Conservation (MAC) Laboratory located in St. Leonard, Maryland where they have a unit 12 feet long and 4 feet wide. This space is large enough to fit all 10 frames and some 9 smaller wood artifacts into the dryer at one time. With everything set in motion, the frames and small artifacts such as two tompions, one small cask head fragment, and a wooden button were carefully wrapped in PEG soaked rags and plastic and transported to the MAC lab in mid-April.

Upon arrival, all the wood was unwrapped and placed on a long cart for easy transfer to the freeze-dryer. Pins were placed in radial, tangential, and longitudinal directions of the wood (July 2008 conservation report) in three of the frames and one tompion. A measurement was obtained between the pins to monitor the amount of shrinkage that occurred during the freeze-drying process. MAC lab conservators have been monitoring the artifacts over the last few months by weighing the wood weekly until each artifact's weight is stable and can be removed from the freeze-dryer.

In July, all the small wood and two of the small frame pieces were stable and ready for transfer back to the lab. Each artifact had very little dimensional changes and the treatment succeeded in maintaining the wood's original shape. The main goal in conserving wet archaeological wood is maintaining the artifact's shape and stability, which has been achieved through the two-stage conservation method using PEG and freeze-drying (March 2004 conservation report). Conservators were very pleased with the results and the *QAR* staff looks forward to picking up the timbers later this fall. We appreciate all the hard work of the MAC lab conservation staff and thank the Friends of *QAR* for funding this stage of the conservation process.

Freeze Dryer on Loan to *QAR* Lab

Independent conservation consultant, Katherine Singley, attended the ICOM-CC WOAM 2010 conference (see below) in May and had the opportunity to tour our lab facilities. Ms. Singley had a wonderful idea and offered to loan the freeze dryer she is not currently using to the *QAR* lab. The VirTis General Purpose Freeze Dryer is equipped to hold an object up to 24"wide x 24"thick x 48" long. As explained above, a freeze dryer is very important to organic artifact conservation such as wood, rope and cloth. This loan will allow us to treat the small organic finds at the Greenville lab. We would like to thank Ms. Kate Singley for her generous contribution and the Friends of *QAR* for funding transportation and installation of the donated equipment.

Identification of Microbes in Storage Tanks with Wood Artifacts

In 2003, some of the *QAR* ship timbers (oak hull and pine sheathing planks) were examined for bacteria and fungi by Dr. Jan Kohlmeyer from the Institute of Marine Sciences, University of North Carolina-Chapel Hill. On one hull plank, fruiting bodies of ascomycete (Ceriosporopsis cfr. Halima) and traces of marine fungi were detected (Kohlmeyer 2003). Since then visible microbial colonies continue to grow in the storage tanks containing ship timbers.

As reported in April 2009, the lab began using a biocide called Proxel BD20 by ArchChemcial Inc. to deter bacteria and/or fungi from growing in the storage tanks containing wood artifacts. Part of this treatment was to identifying species of bacteria and/or fungi present in these tanks. It is important to know what kind of microbes are present and if they are detrimental to the archaeological wood. This in turn will give a better understanding of what microbes Proxel BD20 is subduing.

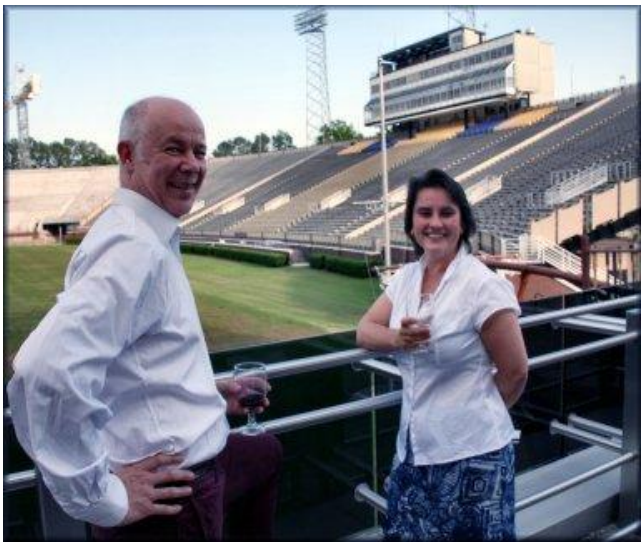
The *QAR* lab has teamed up with Dr. Matt Schrenk, Assistant Professor of Biology at ECU, to help with this study. He and his student assistants have collected multiple samples in various solutions (tap water, RO water, and PEG) from each storage and treatment tank for microbial DNA identification. Some of these solutions contain no Proxel BD20 while others contain a 0.2% Proxel BD20. His ongoing research will be crucial in determining what is growing in these tanks and if Proxel BD20 is effective on the micro-scale. These tests could not be made possible without the assistance of Dr. Schrenk and we appreciate the help.

*Kohlmeyer, Jan, 'Result of Microscopic Examination of Samples from Queen Anne's Revenge'.

ICOM-CC Wet Organic Archaeological Material (WOAM) Conference 2010

At the end of May, NC Department of Cultural Resources, East Carolina University and Colonial Williamsburg Foundation hosted the 11th Triennial Conference of the International Council of Museums, Conservation Committee, Wet Organic Archaeological Materials Group (ICOM-CC WOAM2010). This was the culmination of three years of planning by organizers Sarah Watkins-Kenney at the QAR Lab, Emily Williams in Colonial Williamsburg, and Kristiane Straetkvern at the National Museum in Copenhagen, Denmark. Administrative support was provided by staff of ECU's Department of Continuing Studies.

WOAM conferences happen every three years, the two previous ones were in Amsterdam, Holland (2007) and Copenhagen, Denmark (2004). At the end of each conference bids are taken for hosting the next conference. In 2007 the US delegates submitted a bid to hold the 2010 conference in Greenville, NC, which to our delight and trepidation was agreed.



WOAM 2010 was attended by over 80 conservators and scientists, from 15 different countries (including USA), who have responsibility for preserving wet archaeological organic remains, including

shipwrecks such as the English 16th Century *Mary Rose*, the Swedish 17th century *Vasa*, the 18th Century North Carolina Beaufort Inlet shipwreck (*Queen Anne's Revenge*), and the 19th Century Civil War Submarine *H.L. Hunley*.

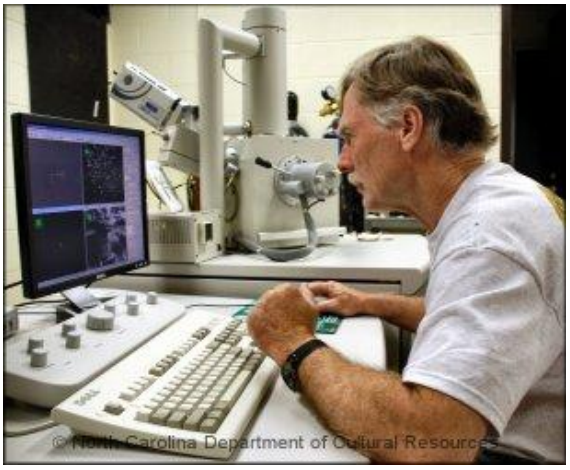
The conference venue was on the main campus of East Carolina University, where, for four days, delegates gathered to present and discuss the challenges and progress of their latest work. Session topics focused on: preserving wrecks and organic materials (such as wood, leather, bone, and textiles), in-situ preservation; research on how materials degrade and how to stabilize them if recovered from sites; and progress in various case studies. From the *QAR* Lab, Shanna Daniel presented a joint paper with Myron Rolston entitled 'Bacteria/Fungi: A Growing Concern for Waterlogged Wood.' Sarah and Shanna were also co-authors on two posters presented by ECU researchers Dr. Anthony Kennedy and Dr. John Kenney, reporting on current work investigating the use of sugars and polyethylene glycol for treating waterlogged wood. If all goes to plan the conference proceedings will be published at the end of this year.

Social Events for delegates included: a pre-conference field trip to Pettigrew State Park and Lake Phelps (Saturday 23); a welcome reception at the Historic Humber House in Greenville (Tuesday 25); an evening at the *QAR* Lab, with BBQ and open house for delegates, which Secretary Carlisle and ECU representatives also attended (Wednesday 26) and finally a conference dinner overlooking the football stadium in ECU's Murphy Center (Thursday 27). Following the conference delegates had the option of a tour to Beaufort NC, - which included a visit to the NC Maritime Museum, Fort Macon, and a boat ride. A second tour was to Virginia to visit Jamestown, Colonial Williamsburg, and the Mariner's Museum in Newport News.

The organizers would like to thank all those who contributed and helped to make this conference very enjoyable as well as an informative event. A definite success to judge from some of the comments we received afterwards: For example:

"I want to thank you and your team for all your endeavors to ensure the smooth running of the conference last week. I know how much work is involved, but I hope you also found it worthwhile and rewarding. It certainly put ECU on the conservation map! ...You guys are doing great work there." –Emma Hocker, Conservator, Vasa Museum

"I just wanted to thank you and the QAR *team so much for hosting the WOAM group so well and so efficiently. It was a remarkable week for us all, mostly because of the precision with which everything was managed. It was a great achievement! It was tremendous to be able to see what you are doing at ECU, and also to see Emily's set-up in Williamsburg."* –Jim Spriggs, Conservator, United Kingdom



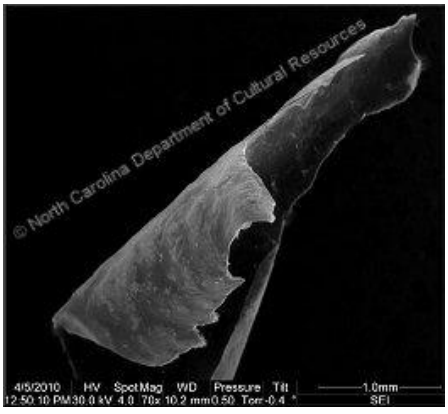
Scanning Electron Microscope (SEM) Training at ECU

Conservators have had the opportunity to begin training on the scanning electron microscope (SEM) with Dr. Tom Fink, lab manager, of ECU's Department of Biology Imaging Core Facility. The SEM is a very useful conservation tool as its use generates images at high magnifications by using electrons instead of light waves. Among the many capabilities of this SEM, the energy-dispersive x-ray spectroscopy (EDS) can be used to examine the presence and absence of certain elements within an artifact. Conservators have been able to image a few organic objects such as rope, horn, canvas and a shell button. Metal objects such as copper sheet and brass button covers have been analyzed with EDS to aid in corrosion product identification.

This allows conservators to make informed decisions about condition assessment and the conservation process. Dr. Fink also teaches an environmental biology laboratory and visited the VOA facility with his students to observe the natural environmental surroundings. The *QAR* lab would like to thank Dr. Fink for the opportunity to learn and use such a resourceful instrument.

Possible Lantern or *Lanthorn* Remnants

In March 2003 lab staff reported on what was believed to be a leather artifact held together with two lead studs (QAR232.020) which was removed from concretion along with a sail needle. The association of leather and decorative lead studs was pondered in the Lead Stud Bulletin posted in February 2008. This artifact has been stored in the refrigerator since its removal from concretion until this spring when conservators started the process of removing the iron staining using a 2% ammonium citrate solution. A small layer of iron was brushed from the surface and upon further investigation the material no longer appeared to be leather. The artifact has distinct layers and a translucence characteristic with linear corrugations. Lab staff now believe the material previously thought to be leather is actually horn. Once the mystery of this artifact's identification is solved the lead stud bulletin will be updated.



Horn is a keratinous sheath which covers the surface of a bony core (O'Connor, 1987). Historically the process of rendering horn to a useful raw material was achieved by applying heat although delicate control was needed to avoid damage. After

weeks of soaking the keratinous sheath was removed from the bony core and set to boil for one to two hours. The horn was then held over a fire to remove the excess water and further heated to facilitate opening and flattening into plates. The horn was then re-softened by boiling after which it was pressed between heated iron plates and smeared with grease. (MacGregor, 1985). Sheets of horn could be used to produce combs, cigar holders, fan sticks, book covers, and veneers for furniture as well as molded into spoons, boxes or umbrella handles. Horn plates were further delaminated into leaves and subjected to pressure making exceptionally thin and translucent *lanthorn* plates that were often used in the windows of lanterns because the material could withstand the heat of a lamp without burning. Horn could be finished to quite a high luster through polishing (O'Connor, 1987 & MacGregor, 1985).

In an attempt to identify this artifact's makeup correctly, conservators have teamed up with Dr. Anthony Kennedy of the ECU Chemistry Department to perform attenuated total reflectance fourier transform infrared (ATR-FTIR) spectroscopy. SEM/EDS has also been used to image the surface of this object. Keratin is a sulfur-containing protein composed of amino acids and is highly reactive under certain marine burial environments (Jones, 2003) so research hopes to identify specific keratin signatures. Spectrums of known horn and similar material such as bone, antler, tortoiseshell, leather and teeth have been obtained to compare with the *QAR* specimen. Archaeological horn is often delaminated, cracked, warped and opaque and possesses longitudinal corrugations that can be seen with the naked eye (O'Connor, 1987). QAR232.020 has many of these characteristics and further research will only aid in the identity of this object. Research will eventually be published in a scientific journal.

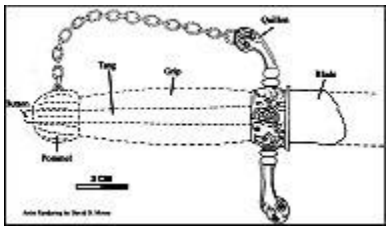
*Jones, Mark, ed. "Conservation of Ivory, Horn, Leather and Bone." *Conservation of a Tudor Maritime Collection. The Archaeology of the Mary Rose* (2003) Vol. 3.

*MacGregor, Arthur. *Bone Antler Ivory and Horn: The Technology of Skeletal Materials since the Roman Period*. Croom Helm, Ltd, Sydney (1985), 66-72.

*O'Connor, Sonia. "The Identification of Osseous and Keratinaceous Materials at York." *Archaeological Bone, Antler and Ivory*. United Kingdom Institute for Conservation of Historic and Artistic Works. (1987) Vol. 5 14-17.

Sword Guard Update

In April 2009 we reported on a sword guard that was recovered in the 2008 field season. This object was on display at the Museum of History for the Knights of the Black Flag exhibit and returned to the lab in January. Conservators have had a chance to clean the artifact and were able to obtain the shape of the blade as well as reveal the decorative markings on the guard. The iron blade extends through the guard and into the handle which is called the tang. On this artifact the handle is missing and remnants of the tang and blade were totally corroded. The iron was cleaned out of the cavity and then cast with epoxy resin, which revealed a one-sided blade. The majority of the concretion on the guard was removed with an air scribe however the final thin layer was softened with electrolysis. During the cleaning process it was observed that the guard was originally gilded with a thin layer of gold of which only small amounts survived intact. The presences of gilding and decorative markings on the guard are of much interest. As more information about this artifact is discovered, the *QAR* team will report their findings.



Computed Radiography (CR) & L3 Communications

For x-radiography equipment at the *QAR* Lab, phase I was acquiring the 225kV x-ray source, which we have been using with x-ray film. Phase II was seeking digital x-ray imaging hardware, preferably a computed radiography (CR) system. Although expensive, (a CR system can be $50,000-$100,000) if we could raise the funds the investment would guarantee a better workflow, provide easier accessibility and reduce long term costs. These digital systems employ a reusable phosphor screen as the medium to capture an x-ray image rather than one-shot conventional film. Once the phosphor screen has an image, the screen is passed over a laser and a digital file is created in ½ to 2 minutes depending on the desired resolution and size of screen. One image on a phosphorous screen can be scanned multiple times at different resolutions and the image can be erased in about a minute using a standard light. The digital format is much more versatile and the image can be manipulated almost instantly to bring out small contrast changes within the image. Film can be scanned digitally but one must have access to a high quality scanner (approx. $50,000 for the unit or contracted $4 per film) to be worthwhile.

The digital format also makes the x-rays more accessible to conservators/researchers and takes up no physical storage space as compared to film. After the initial CR investment there are minimal associated costs other than replacement phosphorus screens that can be $500-$1000, however, they can be used thousands of times if proper care is taken. Film processing continues to be costly because of the film, which is $500 for 100 14”x17, chemistry to develop the film and proper disposal. Film processors have to be serviced everyday while CR systems have no daily equipment maintenance. Finally, CR plates up to 100 inches long can be digitized saving technicians the headache of stitching 14 x 17 inch screens together. Time and money saved make CR systems worth every penny invested in them.

In August, Friends of *QAR* director, Lauren Hermley inquired to L3 Communications Pulse sciences (L3PS) for more information about CR systems in general. Lauren spoke with Dr. Norman Link, a Senior Technical Consultant for L3PS who teaches computed radiography courses and is also an author of the PixelRay software used with CR systems. It happened by chance that Dr. Link was going to be visiting a colleague at NC State University so he decided to drop by the lab and give a demonstration of the All Pro Scan X CR System on August 13th. Dr. Link has a wealth of knowledge on CR and the demonstration was enlightening to lab staff. More details were seen in artifacts that have previously been x-rayed on film, due to the CR system being more forgiving and allowing the manipulation of the digital image right away in grayscale or a variety of color scales. On August 28th Dr. Link stopped by the lab once again to donate four, 14 x 17 phosphor plates and to install the CR system he and L3 Communications have loaned the *QAR* lab. Saturday was spent going through different materials such as concretions of varying thicknesses, organics like cloth and wooden tompions and metal objects with identifying marks to experience the broadest applications we might encounter while using the CR system. We would like to thank Dr. Norman Link and L3 Communications for providing the lab with this opportunity to give computed radiography a test drive.

QAR Artifacts at the Museum

The Knights of the Black Flag exhibit at the Museum of History in Raleigh ended in January, and a number of artifacts returned to the *QAR* Lab either to complete their treatment or for retreatment. Conservation is an ongoing process as explained in our last report. The first bell recovered in 1996 was transferred to the museum in 1997. The interior was showing some signs of corrosion where a small amount of concretion had been left due to the difficulty of removal. The conservation lab has obtained smaller air scribes with longer tips that makes reaching the inside the bell easier so the remaining concretion was removed and then treated to stabilize the metal. The musketoon barrel was transferred to the museum in 1998 and was also in need of retreatment as the outside of the barrel had started to tarnish as well as showing signs of active corrosion. Both the bell and the musketoon barrel

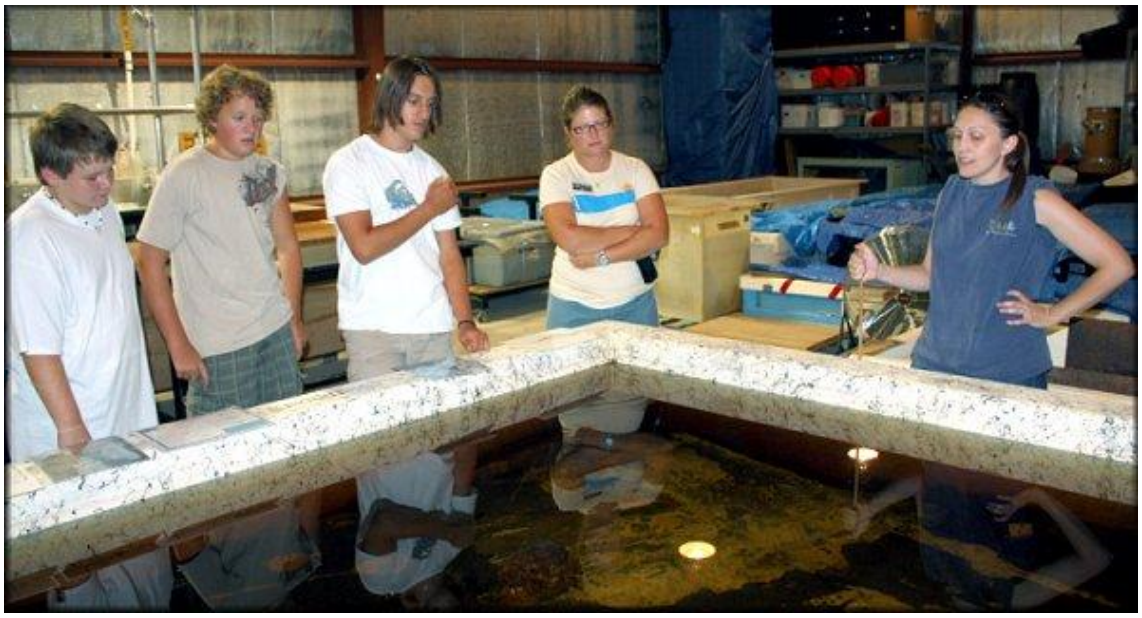
were treated with 3% benzotriazole to arrest any active corrosion and then protected with a 2.5% B72 coating. These artifacts were transferred back to the museum in February and hopefully they will not have to revisit the conservation lab for another 12-13 years.
As discussed in the December 2009 conservation report active corrosion was seen in all the cannon bores. Cannon 19 (C19) & cannon 21 (C21) were transferred to the museum in April 2005 and returned to the lab for retreatment. A few places on the outside of the cannon were in need of treatment as well as the cannon bores. A few loose flakes were removed from the inside of the bore and then the surfaces were recoated with 10% tannic acid in ethanol. An important aspect in maintaining conserved wrought and cast iron is to keep it in an environment with a relative humidity less than 20%. Desiccant is placed inside the cannon bores and must be maintained to keep that condition. C19 & C21 were transferred back to the museum in August where they will again be displayed to the public.

The last report on Cannon 2 (C2), a 6-lber was in April 2009 about the dehydration process. In July, C2 was exchanged for Cannon 3 (C3) that was transferred to the Museum on the Albemarle in November 2007. C3 returned to the lab for retreatment and will undergo the same process as C19 & C21.

The great success of the Knights of the Black Flag exhibition led to the *QAR* artifacts on display at two more pirate exhibits. The South Carolina State Museum in Columbia is featuring an exhibition Pirate, Privateers & Buccaneers which started March 20th and will end January 2011. In July the Graveyard of the Atlantic Museum in Hatteras opened a pirate exhibit featuring *QAR* material. A new *QAR* exhibit will be opening at the North Carolina Maritime Museum in Beaufort in June of 2011. The conservation lab will be working hard in the coming months to get many new objects to the museum for display.

Education and Public Outreach

The past nine months the *QAR* lab has seen many visitors from college students to research professionals. All visitors are given a brief history of the project and then escorted around the lab by staff members, who explain the different conservation processes taking place at that time. Tours are tailored to fit the group depending on their interest.



Lab Tours

Between January and the end of August we have had 19 different groups of visitors to the labs, totaling 237 people. The labs are not open to the general public but by arrangement, and schedules permitting, we can give tours for educational and special interest groups.

An increasing number of ECU classes are including a visit to the *QAR* Labs for students, as part of their course. This year, so far, we have had 4 ECU class tours (41 students) including the Program for Maritime Studies ship construction class, History's Public History class, Anthropology's Caribbean Archaeology class and Biology's Environmental lab classes. In April an Appalachian State University student, Glenn Dion, toured the lab because he was doing a Blackbeard audio documentary for a class project. In June the ECU Graduate and Research Studies department was having a retreat at the VOA facility and the group had a chance to tour the lab. Maritime Studies professor, Dr. Lynn Harris, brought a visiting Namibian archaeologist, Theo Scheoman, by the lab to see the facility while he was in town. At the end of June the Sand Hills Community College archaeology class also toured the lab. In August the NCMM brought there summer camp group to the lab for a tour.

Our biggest group of visitors (100 people), was at the end of May, when delegates at the ICOM-CC WOAM2010 conference attended an evening open house at the lab (see above).

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Lectures & Displays

In February the Pine Knolls Shore Aquarium hosted an AAUS Scientific Dive Symposium where scientists had a chance to gather and share research taking place around the area. *QAR* staff attended the symposium and Lauren talked about developing an effective volunteer program to educate recreational divers in scientific endeavors citing lessons learned from the Dive Down program. Wendy discussed the in situ monitoring project taking place on site to initiate conservation of the larger iron artifacts like cannon and anchors on the sea floor.

In May, Shanna and Terry spoke to the 4th graders at Tommy's Road Elementary in Goldsboro about the *QAR* project. These students were studying North Carolina history so they were able to learn more about the pirate Blackbeard and see a few artifacts. This summer Wendy was a guest speaker for the Onslow County Libraries' Summer Reading program, 'Making Waves at your Library.' Wendy visited all four libraries in Jacksonville, Sneads Ferry, Swansboro and Richlands speaking to youngsters and their parents about the *QAR* project and attendees were able to see a few artifacts before and after the conservation process.

QAR lab staff also attended two Saturday events, one in the spring and one this

summer. On May 15th, Sarah, Wendy and Shanna, talked to many visitors at the 6th annual Bath Fest in Bath, NC. This summer the Department of Cultural Resources hosted Second Saturdays at various historic sites across the state. Sarah and Shanna talked to the public about the project and displayed artifacts at the Graveyard of the Atlantic Museum in Hatteras in July. At this last event we focused also on aspects of the science behind conservation. For example, visitors to the museum were able to test for themselves the pH (acidity/alkalinity) of different conservation solutions, to weigh different artifacts, and view x-rays. There was also a conservation quiz, for which the answers were either in the *Queen Anne's Revenge* exhibit at the museum, or at the conservation show and tell table.