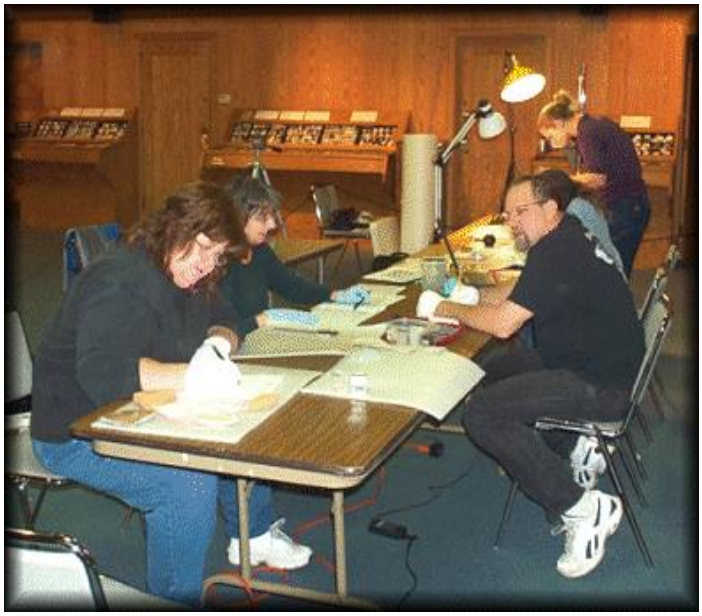
Queen Anne's Revenge

Conservation Laboratory Report
UAB Conservation Laboratory, Greenville
Sarah Watkins-Kenney *QAR* Project Conservator
Wendy Welsh, *QAR* Laboratory Manager
Eric Nordgren, Project Assistant Conservator
March 2004

March has been eventful for the *QAR* conservation staff. Major activities have been working with curators at the North Carolina Maritime Museum on a review of *QAR*artifacts at the Museum and deciding on the conservation treatment most appropriate for the *QAR* wood. One of our "old friends from the sea," marine fungus, has showed up again on some of the wood and been identified and dealt with. Our ECU Maritime Studies student volunteers continued to be a great help to us but have now finished for this semester. Development of the laboratory continued with the setting up of a dust collection system at the air-scribing station in the warehouse. With this set up we can now safely progress the work of extracting artifacts from concretions.

North Carolina Maritime Museum (NCMM) Artifact Review



There are hundreds of objects from the *QAR* Project now at the NCMM. These objects are either on display, available for study in the Repository or part of a traveling exhibition. On March 15th, Mark Wilde-Ramsing, Sarah Watkins-Kenney, Wendy Welsh, and Karen Browning met with Curators Connie Mason and Frances Hayden to review artifacts on display. This was the first of several such sessions that will be needed to check all the *QAR*objects at NCMM. We worked in the auditorium and visitors to the museum were able to view our proceedings. Artifacts were examined for further corrosion or degradation after being on display, some for 6 years. All objects were weighed, measured, drawn, marked with correct numbers and photographed. Another objective of this review was to check that the museum and conservation lab's records (held on the NCDCR Archaeology database known as ArtCat) tally.

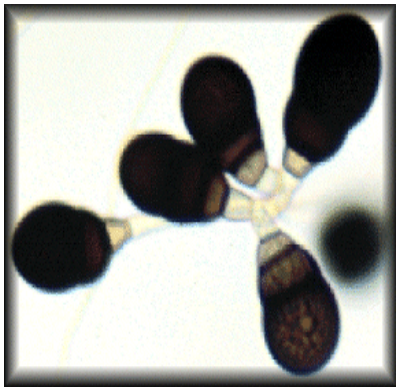
The database enables us to keep track of objects and to generate reports for the Museum that

include recommendations on storage and display conditions for conserved artifacts. The strong partnership between the conservation lab and museum will continue as conserved artifacts are transferred to the NCMM. We have also agreed with the curators to continue to check the condition of objects several times a year.

An "Old friend from the sea" - Marine Fungus on QAR Wood

One of the challenges for conservators of marine archaeological wood is to prevent, or at least minimize, continuing biodegradation of the wood whilst it is in wet storage prior to conservation treatment. Dr. Jan Kohlmeyer, Professor Emeritus at the University of North Carolina, Institute of Marine Sciences in Morehead City, has been a consultant for the*QAR* team since 1997. A world expert on marine fungi, Dr Kohlmeyer has examined the*QAR* wood at various times. In 1997, Dr. Kohlmeyer examined a sample of wood from a piece of the hull that was still on the seabed. He found:

"…no trace of fungal fruiting bodies or soft rot decay (indication of growth of marine fungi). Possibly, fungi had developed earlier when wood was sufficiently aerated, at a time when also woodborers settled…The wood is extremely riddled with wood borers: 1. Shipworm (Teredinidae: can only be identified after splitting the wood and searching for shells and pallets); 2. Pholads [Pholadidae: probably Martesia striata (L)]."



By November of 1998, Dr. Kohlmeyer had analyzed 7 further wood samples from the hull timbers still on the seabed.

"All were heavily decomposed and softened by bacteria, but only a few pieces contained intact boring and fouling animal, such as barnacles, bryozoa, hydrozoa, boring clams, pholads, shipworms, and very rarely marine fungi, the animals in the majority of the boreholes have long been decomposed. These results indicate that the ship had been covered by shifting sand and anoxic conditions killed the boring and fouling organisms. Very recently, the ship became exposed again, and a new set of animals colonized the wood."

Dr. Kohlmeyer has identified many of the species that are still living in the wood, but the presence of fungi can only be detected when it is in the fruiting stage of its life cycle. This month we noticed a small amount of fungus growing on the surface of one of the hull planks. A sample was sent to Dr. Kohlmeyer for identification. He reported that it was a fungus mycelium (a network of hyphae made from new cells that have elongated and split repeatedly forming a network) with many corridia of *Trichocladium achrasporum*, a different

fungus species to that found in November 2003. The fungus will soften wood but does not penetrate deeply. It is noteworthy, that after four years of freshwater storage marine fungi are still viable, but according to Dr. Kohlmeyer they are very adaptable to changing conditions. Having had confirmation that what we had observed on the wood was indeed marine fungus, which would lead to further deterioration of the wood if left, our next task was to remove it, and prevent or at least inhibit further growth. All the timbers were brought out of their tanks and cleaned with soft brushes under running water to remove any visible living fungus. The tanks were emptied and thoroughly cleaned before refilling and replacing the wood in them. We do not want to use chemicals to kill or prevent fungal growth, for environmental, health and safety reasons. We hope to inhibit further biodegradation by changing the water in the tanks weekly and by excluding light with covers until conservation treatment begins. Our selected treatment for the wood should kill off our "old friends from the sea."

Dr. Kohlmeyers report can be found on the *QAR* web page.

Conservation Treatment of Wood

The main aim of a conservation treatment for waterlogged wood is to remove the water and dry the wood. The problem is that in degraded wood the water is acting as a bulking agent - physically supporting what remains of the cell structure and preventing collapse of the wood. Although the timbers from the *QAR* may look strong and not so different from new wood, if they were allowed to dry out without replacing the water with a different bulking agent, they would irreversibly shrink and distort on drying. Over the years various treatment methods have been developed using different materials as bulking agents, for example, rosin in acetone, sugar, silicone oils and polyethylene glycol waxes (not to be confused with ethylene glycol which is used as antifreeze in cars!).

Since the *QAR* timbers were transferred to the VOA lab we have been investigating treatment options through discussions with colleagues and through researching published articles. We have also been testing the wood to determine its condition, as this will be an important factor in developing a treatment program. Some of the testing methods were described in last months report. The results of the testing to date indicate that the oak timbers (hull planks and frames) have a somewhat soft spongy outer layer, but that the majority of their bulk is relatively hard and well preserved wood in the center. The degradation of the pine (sacrificial sheathing) appears to be more uniform throughout the object. While the goal of conservation treatment is to maintain the original size, shape and appearance of the wood, it is also a requirement that the methods used should not be hazardous to the conservation staff, or to museum staff and visitors at the NCMM where the timbers will be displayed and stored after treatment. It is also important to ensure that the treated timbers will remain stable in the environment and conditions at the museum (NCMM). Although under normal circumstances the environment is controlled at the Museum, we would aim to ensure that the timbers remained as stable as possible in a worst-case scenario should HVAC at the Museum fail, as for example could happen during a hurricane.

Taking all these factors into consideration we have decided that treatment using Polyethylene glycol wax (PEG) will be the most suitable method for conserving the *QAR*timbers. Treatment with PEG was selected as it has a number of significant advantages. PEG has been in use to

conserve waterlogged wood for 30+ years and has been proven to be effective. There are many documented successes and a large body of conservation literature on PEG treatment. Used as a solution in water, PEG does not require specialized equipment and treatments can be carried out in existing fiberglass tanks. PEG does not present a hazard to conservators or the public; solutions are not flammable or hazardous unlike methods using solvents such as the acetone-rosin method. Bulking with sugars is inexpensive but can lead to pest problems; PEG does not attract pests or encourage bio-deterioration of the wood. PEG solutions over 20% are toxic to molds, fungi, and microorganisms. While silicone oils have given some promising results, they are irreversible and prohibitively expensive in the quantities required for the *QAR* timbers.

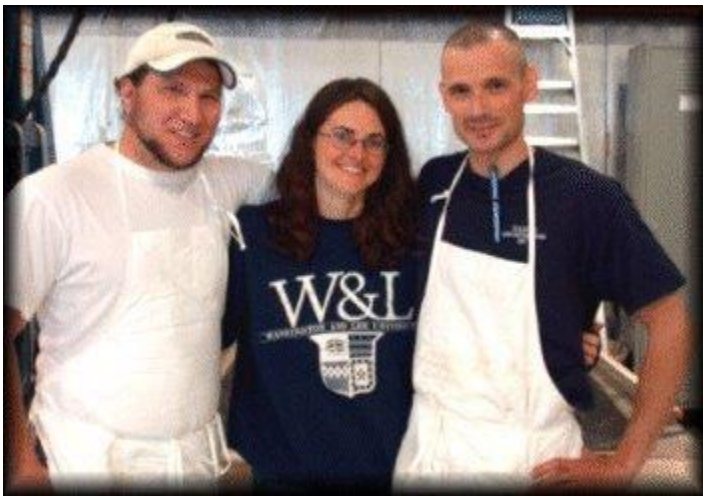
Once the decision to use PEG was made, there was the task of choosing the correct molecular weight (MW) for the wood we have. All PEGs have the same basic formula but their properties at room temperature vary depending on the molecular weight of that particular PEG. Those with a low molecular weight, and thus relatively small molecule size (e.g. PEG 400) are liquid at room temperature, whereas those with a high molecular weight, and larger molecule size (e.g. PEG 4000) are solid. PEGs in between can have the consistency of Vaseline (e.g.540 blend). All PEG waxes have a tendency to be hygroscopic (absorbing water from the air) but this property decreases as MW increases.

It has been found by other conservators that most successful treatments of wood with PEG have used a two-stage treatment using first a low molecular weight PEG and then a high MW one. Timbers are soaked first in a solution of PEG 400 in water and then in PEG 4000 in water before drying. This two-step process is particularly good for treating waterlogged oak, which typically has a degraded outer layer and less degraded core. Researchers have shown that the low MW PEG 400 penetrates readily into the smaller cellular spaces of the less degraded wood and that it chemically bonds to the wood structure replacing chemically bound water. The wood is then soaked in heated solutions of PEG 4000, increasing the concentration of PEG 4000 until it is at a level where it would be solid at room temperature. Thus the PEG 4000 acts as a bulking agent, replacing the water, in the cell voids. This treatment process will take many months.

PEG 540 blend is a mixture of MW waxes that has been used by some conservators to treat wood in a one-stage process. However PEG540 blend has disadvantages over two-stage PEG400/4000 treatment for the *QAR* timbers. PEG540 blend has a very soft consistency at room temperature and is much more hygroscopic than PEG4000. This could cause the PEG540 to become very mobile and even leach out of the wood if exposed to the very high relative humidity that can occur in North Carolina. Another problem with PEG540 blend is that it is a mixture of molecular weights in between PEG 400 and PEG4000. The lower MW wax in it is likely to be too large to penetrate into the small cell spaces of the relatively un-degraded core of the oak timbers. Its higher MW component has a soft pasty consistency at room temperature and is thus not strong enough to physically support the more degraded outer layers of oak nor the degraded pine.

We have decided to use a two-stage PEG400/4000 treatment for the *QAR* timbers and will report on progress in future monthly reports.

ECU Maritime Studies Student Volunteers



Since the beginning of February, Matt DeFelice, Liz Whitfield & Franklin Price (all ECU Maritime Studies Masters students) have been volunteering at the conservation lab on Wednesday afternoons. Tasks have included collecting samples from treatment tanks to be tested for chlorides and checking solution levels in treatment tanks and filling them up with more sodium carbonate solution when required. They have helped to make 1:1 drawings of timbers and concretions, and to record cannon measurements. Their assistance was invaluable in constructing the dust collection system for the air-scribing station in the warehouse. The QAR Lab has greatly benefited from their input. We appreciate all the hard work and wish them well through the summer and hope to see them again in the fall semester!

That's all for this month, next month more on the QAR cannon and get a look at Parker's new donation.