DOWELS, POWDER AND CRACKS: COLLABORATION IN THE PRESERVATION OF A 12TH-CENTURY PORTAL FROM BORDEAUX

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Collaboration is defined as working jointly with others, literally laboring with others, one assumes to some common goal. At the Isabella Stewart Gardner Museum, it has become abundantly clear to me over the last ten years that preserving works for the future can never be an isolated process, but requires constant collaboration with anyone who can possibly affect the future of a work. In terms of a late 12th c. stone portal from Bordeaux, I am a collaborator in the preservation of this work with the artist or artisan who designed the work, chose the stone and method of working it; with all past owners, handlers, dealers, restorers and conservators who have written their chapters into the preservation of the life of this work; and with Isabella Stewart Gardner herself, who chose to have it installed within a supporting wall of the museum. But the collaboration does not stop there: preservation of the work requires the direct assistance of staff of nearly every department of the Museum in one way or another. The education staff, special events staff, and others are actively engaged in seeing that the works are exposed to the public. They inform the public of the fragility of the works. The maintenance staff clean up after the visitors and must be careful that their equipment does not damage the stone. They also give any fragments they find to the conservation department. The building supervisor and construction crews who repair the building must be very careful that their intervention does not cause undue vibration and further deteriorate the stone. Finally, our largest group of collaborators in preservation are the visitors themselves, 170,000 of them each year, who are either thoughtfully disposed or not when they visit the piece.

In 1865, an antiquarian named Leo Drouyn published a book entitled La Guienne militaire. Through several engravings, he depicted a Romanesque edifice, a grand house from the late 12th c. known as Maison Seguin or sometimes Maison de la Synagogue, as it appears to have sat opposite to a synagogue in the ancient Jewish quarter of La Reole, a town located on the Garonne some fifty miles upstream from Bordeaux in France. The name of Seguin was of an old influential family of the region, documented at La Reole as early as the 14th c. One engraving showed the entrance portal which crowned the front steps and landing to the house of Seguin. Unfortunately, the building was destroyed only a little after M. Drouyn completed his study.

Not until after 1934 was it realized that the portal of Maison Seguin had been acquired by Isabella Stewart Gardner and installed within the structure of the Isabella Stewart Gardner Museum in Boston. The upper portion of the portal, just under the polylobed arch, is adorned with three heads now thought to be the head of Christ, Mary, and St. John. They are placed over a horizontal lintel, which has been carved with a meander motif. The arch is supported by four pillars of mortared stone, which are further adorned with engaged columns. The columns are capped by two grotesques. The two other piers are capped with simpler capitals, adorned not at the sides, but only under the lintel: one side bears a carved knot in relief, the other a flower. The columns rest on simple curvilinear bases and the piers on rectangular stone blocks. The work has been cut from a pink-yellow sandstone, but the surface in general is nearly black.

The work was purchased for a sum of $14,000, a good sum of money in August of 1914, but was not delivered until two years later, due primarily to the activities and chaos caused by World War I. In 1916, Isabella created her renowned gallery, the "Spanish Cloister", as a suitable setting for the painting, *El Jaleo*, by John Singer Sargent, which she had just received. Within the newly built western wall of this gallery, she installed the portal. It again functions as a gateway, this time to the courtyard of the Museum.

Now to move on to more contemporary issues with the portal. The first collaboration is a collaboration in time, the documentation left to the conservator to evaluate change of condition in the work since its installation. As we work through the images available to us, it is clear that the sculpture is not deteriorating so much with a bang or a bust, but with a slow rain of powder, and surface exfoliation. In notes in the treatment file of the work, we find listed loss of stone crust to the Head of Christ in 1981. This was linked to a possible concert in the room above the night before. Other sandstone was collected during the following week. The gate was closed off, and it was around this time that efforts were made to consolidate the stone with MTMOS. Some staining occurred and the work was stopped. Deterioration was again noted to the right grotesque in April of 1987. The piece was consolidated locally with 3% B72 in Methyltrimethoxysilane.

This kind of deterioration is very typical of chemical deterioration of limestone objects in the Museum. Gypsum is formed by reaction of the calcium carbonate of the limestone with sulfur dioxide, in the presence of humidity and carbon provided by air pollution. The gypsum is physically larger than the original limestone, due to the incorporation of two molecules of water, as well as the larger sulfur atom. This volume change causes a small explosion to occur on the surface of the stone with a resultant powdering and exfoliation.

In October of 1987, Eugene Farrell and Paul Whitmore, then at the Center for Conservation and Technical Studies (now the Strauss Center) of Harvard University Art Museums, were contracted to undertake petrographic, x-ray diffraction and SEM investigation into the deterioration of the piece. They identified the stone to be a calcareous feldsparic sandstone. Forty to fifty percent of the sample was composed of quartz, another 10% K feldspar, 15-20% $CaCO_3$, with the balance being mica, iron silicates and iron oxide. The overall tan color of the stone was due to the weathered iron oxides and hydroxides which stain the material.

One of the most significant features of the thin section was the revelation that the layer of sulfur-reacted stone (i.e. unstable gypsum) went quite deep, 0.140-1.2 mm in thickness. The layer has incorporated a considerable quantity of soot (i.e. carbon) which accounts for the stone's overall black appearance.

The recommendations of the scientists were to trace the source of the sulphur contamination and eliminate it if possible. They also stated that the lack of humidity control would remain a critical problem for works at the Gardner. I am now happy to say that by the end of this summer, the Gardner will have full climate control installed and working. Their report was used in the numerous grant applications for funding for this project, and is therefore collaborative in this larger project as well.

In 1989 we decided to undertake a more thorough investigation of the interior dowels of the portal. There was evidence of corrosion in some areas of the stone blocks of the pillars which seemed due to the rusting of the interior dowels. The area of greatest concern in terms of instability, however, was the upper right block of the arch near the head of the right grotesque. This block had a horizontal crack transecting it. In the front (east) face the crack was further transected by a vertical crack. At this juncture, the upper section of the stone appeared offset from the lower by about 1-2 mm, making it suspect that further rusting of an interior dowel was occurring here. There also appeared to be a small area of previous repair at the point of intersection of the cracks.

We considered using a pachometer to locate the metal within the stone, but we wanted more information than that would provide. We also considered investigation by ultrasound; however, this was more expensive than the alternative, gamma radiography, which appeared to give us comparable results.

We went with a firm familiar to the museum, Briggs Associates, and contracted with them to make gamma radiographs of the portal and other works of stone in the museum. Gamma radiography was done in situ using an Iridium 192 source. The galleries both above and below had to be emptied of people during the period of exposure, which lasted about 20 minutes, although the set up between exposures took longer. The entire process of obtaining several exposures with several types of film took about four hours and development was done on site, in order to assure that effective exposures were obtained.

The resulting radiographs confirmed the existence and placement of dowels throughout the stone, presumably put there during installation in the gallery in 1916-17. They also confirmed the presence of not one, but two dowels at the site of the horizontal crack. I must add however, that the radiographs have since been criticized by other corrosion experts for their quality. Although they met our need to know placement, it is difficult to read anything about the condition of the dowels. On reflection, it might have been better to have gone with a firm more experienced in radiographing stone to get better quality radiographs, and to have had the advice of later consultants regarding what is possible to achieve. This leads me to one of my basic tenets in collaboration: go with the best. Usually, you will find that they are intrigued by your problems, and often they will help you for free or at a reasonable rate. They can also often help you with other contacts to experts who can be of help. And in an area where you are not an expert yourself, you need to be able to trust the experience and ability of your collaborator. It is also useful to work with someone with a track record, who will still be there in the future when you need them for follow-up.

Once the presence of interior dowels had been established, the thinking followed that these were corroding during the periods of high relative humidity at the Gardner. The Gardner Museum has not had any means of reducing relative humidity through most of its existence, and has routinely experienced high temperatures and humidity during the months of July and August. There are even two recorded instances of the interior climate actually hitting 100% RH, i.e. condensation.

Most object conservators are familiar with this situation and know that the normal course of action is to take no chances and remove the offending dowels. In this case, however, we were dealing with a very fragile piece of stone, mortared with Portland cement and doweled into a 20" thick brick wall. Since removal did not seem possible, Valentine Talland, Associate Conservator in Charge of Objects at the Gardner, and I began to look into cathodic protection as a means of limiting the corrosion of the interior dowels.

Early in 1990, we contacted Dr. Robert Baboian, a corrosion engineer, who has worked with conservators on issues of preservation, including the corrosion of the Statue of Liberty. Valentine met with him in December of that year, and we were surprised to find that he doubted that active corrosion of an iron dowel could occur within a material from high relative humidity alone. He thought there would have to be a source of water, perhaps from condensation. To settle this issue, he suggested taking a boring through the stone to the dowel, measuring the potential with a voltage meter at the dowel during periods of high relative humidity, and using the core sample for analysis of the different layers by SEM.

He suggested putting together a team of other experts to look at the problem, including Mr. Neil Burke, a corrosion engineer at WR Grace in Cambridge. This was very helpful, and brings me to another point about collaborations: if at all possible, work with someone nearby (within a day's round trip) so that you can get together in front of the object from time to time.

Mr. Burke visited the department in February of 1991 and again looked at the radiographs of the horizontal crack in the portal. He too was not convinced that the crack was related to corrosion of the interior dowels. The steel did not appear so badly corroded to him, and the lateral rather than radial crack pattern suggested to him fluctual or sheer stress. Even if corrosion were occurring, he did not think that cathodic protection would be much of a possibility. At best it would be very localized.

At about the same time, the plans which the Museum had made for the installation of a full-climate control system began to come to fruition. We were awarded a National Endowment for the Humanities National Heritage Protection Program grant of just over $400,000 to begin the first phase of installation. With the reduction of temperature and relative humidity to acceptable levels year-round, we made the decision to leave the subject of the corrosion of the dowels for the time being, and to concentrate on loss associated with the powdering of the surface.

In March of 1991, Valentine and I decided to consolidate the stone of the portal using ProSoCo Conservare OH, a silicate ester. These silicate esters are both effective and highly toxic in that they react with sources of water to create polymerized silicate networks. In high enough quantities the fumes will cause cataracts to humans, and earlier work in the museum's courtyard had shown that the material will kill plants. Therefore, significant efforts were taken to mitigate the noxious nature of this material during application in the museum gallery.

The building supervisor and Valentine worked together to create a large, ventilated polyethylene box around the portal. The wrought iron doors of the adjacent gate were removed. Wooden two by fours were put up against the brickwork next to the portal, and polyethylene was stretched over them to form a box, large enough for one person to get into with a ladder. The edges of the polyethylene were taped to the wall and the box was sealed shut, except for means of egress, air supply and the attachment port of flexible duct hosing. The hosing extended from the box to the doorway out into the garden, about 20 feet away. In the door to the garden, the hose terminated in an attachment to a fan. The door was sealed up around the fan to provide the maximum draught. Note that in this case the fan was industrial, but not explosion proof. At the time, we counted on the good draught of this fan to keep the vapor pressure of inflammable material down below its flash point. However, we have since obtained and would recommend an explosion proof fan for all such future operations. Valentine was completely suited up for the application of the consolidant including full face mask, gloves, and protective clothing.

It is recommended that the consolidant be applied in three cycles of three applications each. However, due to the difficult nature of the work, we used only one cycle of three applications with satisfactory results. The consolidant was applied by brush to the more stable surfaces and by spray at 10-14 psi to areas of high relief carving, the underside of the lintel and arch, and to the fragile areas of the grotesques. A spot test of the recommended MEK rinse resulted in complete leaching of the consolidant, and therefore was not done.

The work was done on a day when the museum is normally closed to eliminate exposure to visitors. The chamber and fan were left in place to ventilate the area during work hours, when security details could observe the area. At night, the chamber was sealed up and a portable charcoal air-purifier was placed within to absorb the fumes. This was moderately effective. After four days the chamber was disassembled.

The goal of the treatment was to have the consolidant penetrate and polymerize in the fragile layer of sulfation and to tie this layer to the underlying stronger stone. This appears to have been achieved. We know that the consolidation application has worked well, albeit not perfectly, in that we now receive fragments of stone rather than loose powder. The advantage is that these fragments can often be re-adhered in place, whereas powder is lost forever.

A question that continued to haunt us was whether the installation of the portal into a load bearing wall of the museum utilizing an extremely rigid mortar, i.e. Portland cement, was causing further deterioration. This manner of installation is not recommended: preferable would be a free-floating installation that relieves the stone of the stress of support and damage due to settlement of the building, and allows no translation of vibration from the floors above. To answer this question, we contracted for yet another study of the portal in December of 1994 with LeMessurier Consultants of Cambridge, a structural engineering firm. They determined the live load capacity of the Tapestry Room above the portal, but could not determine by nondestructive means either the structural construction of the ceiling directly above the portal or the compressive strength of the stone to know whether it could accept the load.

The results of the analysis showed that the vertical compressive stress in the brick wall on the north and south sides of the portal was well within safe allowable limits. This was good news for it meant that at least the portal was not bearing more of the weight of the building than other areas of brick wall.

The natural vibration frequency of the Tapestry Room floor was calculated and was found to be safe for walking and sitting. They were however, able to measure a displacement in the horizontal crack of the right capital when the room was full of people for a concert. The measured displacement was small, 0.0007 inch, but statistically significant. As a result, the structural engineer, Kenneth Wiesner, has recommended that there be no dancing in this room within a zone of about 300 s.f. around the portal placement below. (Note that there had been dancing in this room in 1993, and in 1988 clog dancing.) In conjunction with this project, Valentine undertook a complete photo documentation of the condition of the portal, to serve as a benchmark for measuring future deterioration.

Last year, the Museum began the second phase of climate control and a new collaboration has developed: between conservation staff and the construction crew. It was difficult, especially during the early phases which involved demolition. We have protected these pieces during demolition by wrapping them in plastic to contain the fragments and supporting them underneath by wooden structures. One fragment was found in this way and has been reattached. The last fragment received showed that the deterioration of the right capital had gotten worse with the construction project. We will still be able to adhere the most recent fragment back in place after conclusion of the project, now slated for September 1, 1996.

In summary, I believe we have make good progress in our attempts to conserve this stone. We have a much better understanding of the underlying problems affecting the portal. We know that the silicate consolidation has helped by giving us larger, better consolidated fragments which can be reattached to the edifice. And we know that vibration, both above, below and in adjacent galleries is a real concern. We have systematically assembled good photographs in both black and white prints and color slides to act as a benchmark in measuring future deterioration. Our next project with this stone will be to fill and inpaint the losses using reversible paper fills, again to serve as a means of monitoring deterioration. Last but not least, with the introduction of full climate control we expect the subject of rusting dowels to be put to rest. Our information and success has been gained through a series of deliberate collaborative efforts. But, in a larger sense, I see a major part of the work of conservation of this piece as letting others know of their role as collaborators in the life of this work.

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