# The Brown Charter: Digital Discoveries

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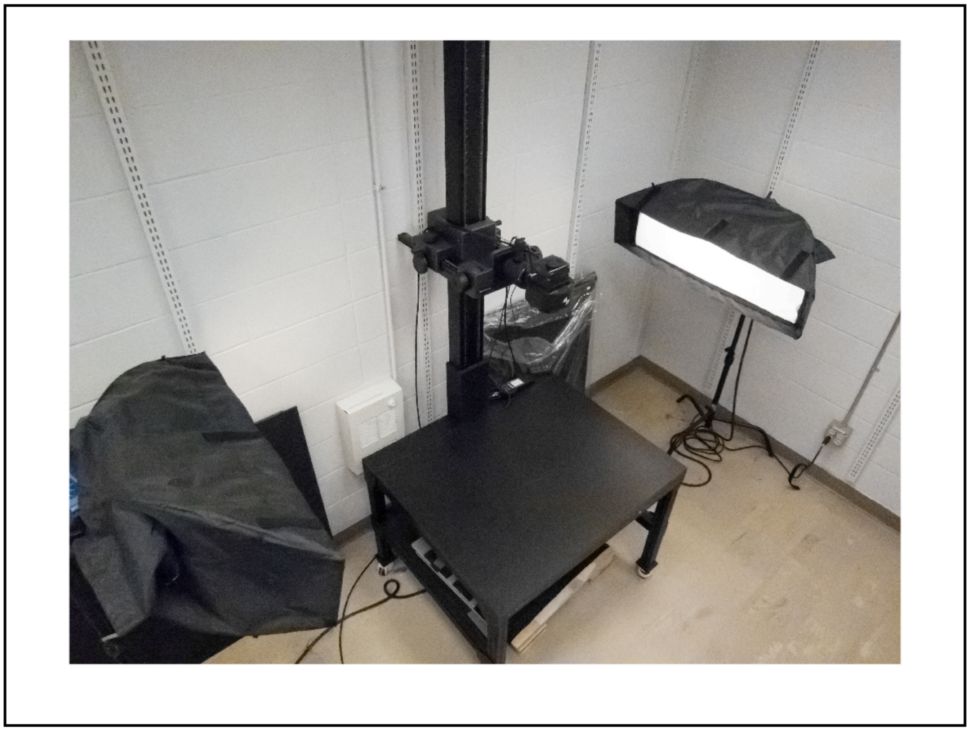
Standard Methods of Digitization:
The Reprographic Setup

Section 1

**Slide 3: Camera Room/Straight On**

Before moving into the details of the more alternative processes that Rachel and I used for imaging the charter, I thought it would be useful to take a quick look at our standard digitization setup. This shows our camera room with the reprographic setup we use for documents and books. We have a 30 x 40 inch platform, which is carefully measured and calibrated so that it is as level as possible. The camera itself is mounted on a rail, and we have hand controls that allow us to raise or lower the camera to suit the size of the object we are photographing. The camera is also carefully measured and calibrated to ensure that it is level with the platform, so that the field of focus remains constant across the image. For lighting, we have strip softboxes that are equidistant from the platform, illuminating the platform at the same 45 degree angle to ensure diffuse, even lighting.

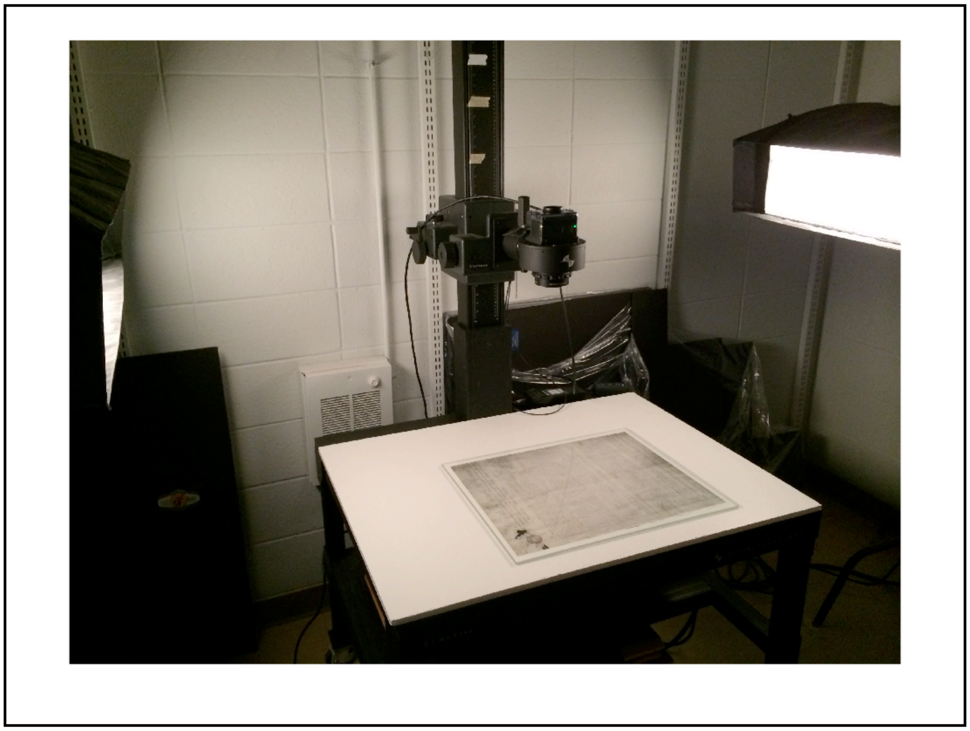


**Slide 4: Camera Room/Above**

From above, you can get a better view of the platform and the rail and mounting system that allows us to raise and lower the camera. You can also hopefully tell that our walls are painted a neutral light gray to reduce unwanted color casts and reflections as much as possible.


**Slide 5: FADGI**

Our digitization workflow - from hardware to software to the room's conditions - is designed to conform as much as possible to the FADGI guidelines. These federally-developed guidelines provide a framework for judging just how accurate our digital reproductions are. By implementing a digitization workflow that is as close to four-star compliance to these guidelines as possible (it is a four-tier system, so 3-4 star compliance is considered quite good), we can be assured that we are creating true and accurate representations of the objects that we digitize.

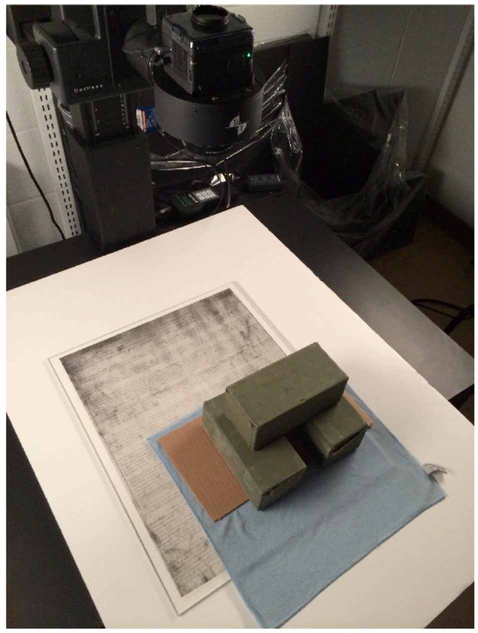


**Slide 6: Basic document/photostat**

So here is a basic setup for digitizing a flat document. We have Optium Archival plexi above this object to keep it as flat as possible, since it had been stored folded for many years. This is actually the photostat of the charter that Rachel had mentioned earlier.

**Slide 7: Basic book**

This is a basic setup for a book; sometimes we use foam wedges to support the materials, but we also have two different kinds of books cradle that we can use to keep the books open for digitizing without causing them harm or stress. Note that we have a target present here - we put these targets in every shot, and they provide us with references for the white and black points, the white balance, and multiple colors. The rulers also provide us with real-world size references. ( Because of the plexi's size, I had taken a reference shot of a target in the earlier picture, then moved it out of the way to accommodate the photostat).

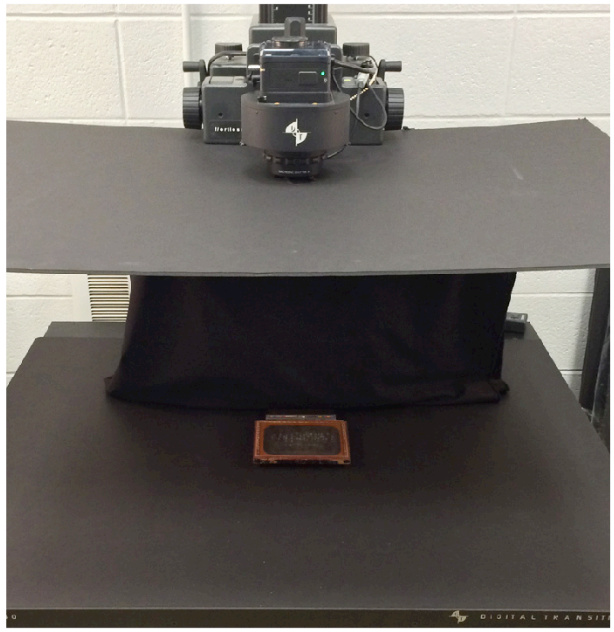


**Slide 8: Involved setup/flattened photostat**

The following are some of the more unusual setups that we have created in order to digitize materials. This is the photostat once again - did I mention it had to be flattened?

**Slide 9: Involved setup,large foldout**

This book had a very large foldout that required special handling to capture the entire image (in multiple shots that were then stitched together).



**Slide 10: Involved setup/daguerreotype**

Photographing this highly reflective daguerreotype required building a set to reduce reflections from the camera and the room itself.

The Brown Charter:
Standard Imaging Practices

Section 2

**Slide 12: Charter basic**

These are images of the charter, as shot according to our standard specifications. It is flattened under glass, and you can see the targets in each shot.

**Slide 13: Detail of charter**

These were who at 600 ppi, so there is good detail in the shots (but no extra details).

**Slide 14: Charter and box as objects**

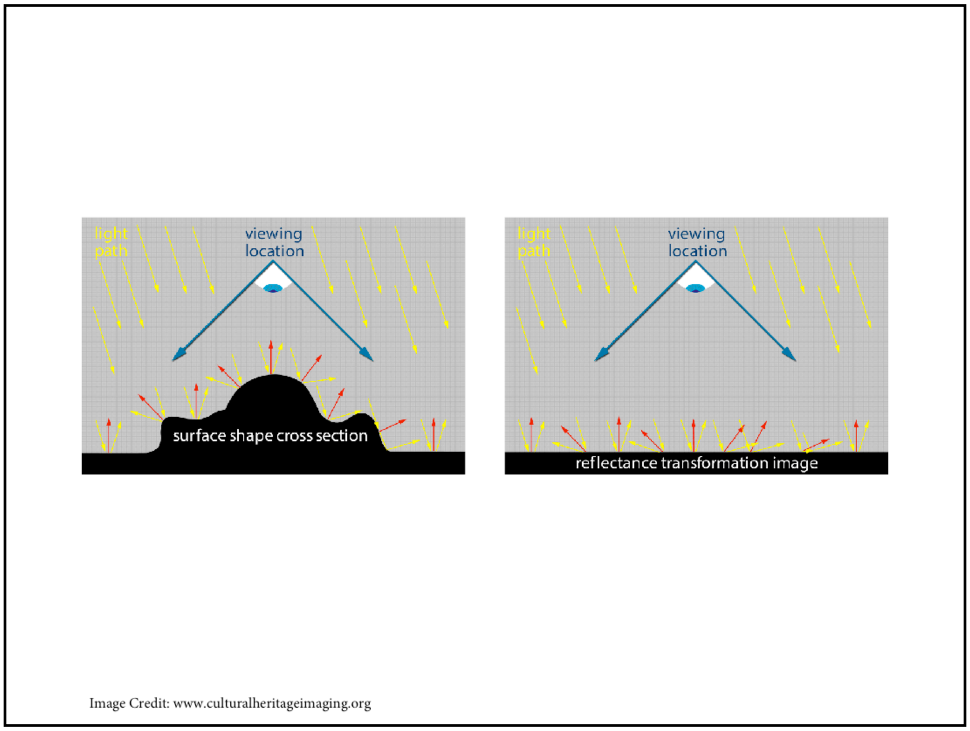
I also photographed the charter and its metal box as objects. I shot these using a separate camera and lighting form our reprographic setup to capture how they look when not flattened/real world.

Beyond the Standard Part I:
Reflectance Transformation Imaging

Section 3

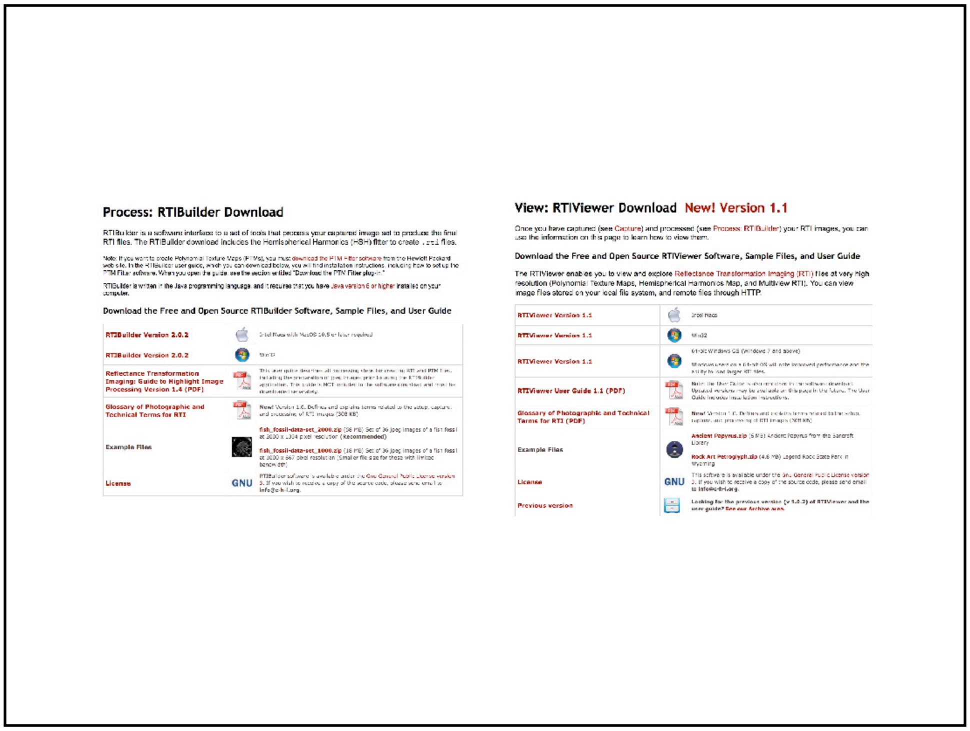

**Slide 16: RTI/CHI**

The first alternative process that Rachel and I tried was Reflectance Transformation Imaging, or RTI. Although RTI has been around since 2001, it wasn't until 2006 that the team at Cultural Heritage Imaging developed newer methods (using specular highlights, which I'll explain shortly) that it became more widely used.



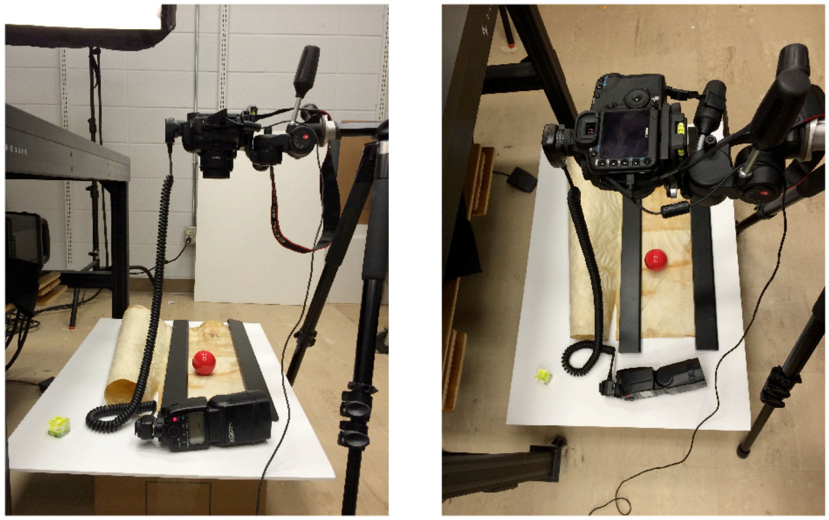

**Slide 17: RTI/Process**

RTI is a process of computational photography that focuses on an object's surface shapes and color. Without getting too technical (and getting myself into trouble), essentially uses the measurements of light reflecting off an object from multiple directions to generate a mathematic model of the surface of the object. This is accomplished by making multiple images of the same subject, with the camera and subject in the same position, and using a single light source whose position changes for each shot. After analyzing these images, the RTI software is able to learn how light reflects off the surface. Although it's a 2-dimensional image, each pixel is encoded with this 3d surface information, allowing the user to manipulate light and shadow on the image to examine fine detail on the object's surface. While there are several methods that can generate this type of image, Polynomial Texture Mapping (PTM) is the most common.




**Slide 18: RTI/Software**

RTI does require special software to create these objects for viewing, and special viewing software to manipulate the lighting on an object and inspect its surface qualities. However, both pieces of software are open source, and easily downloadable from the Cultural Heritage Imaging Website. They also provide tutorials - the software is moderately user friendly, but you need to study it closely to really know what you're doing.

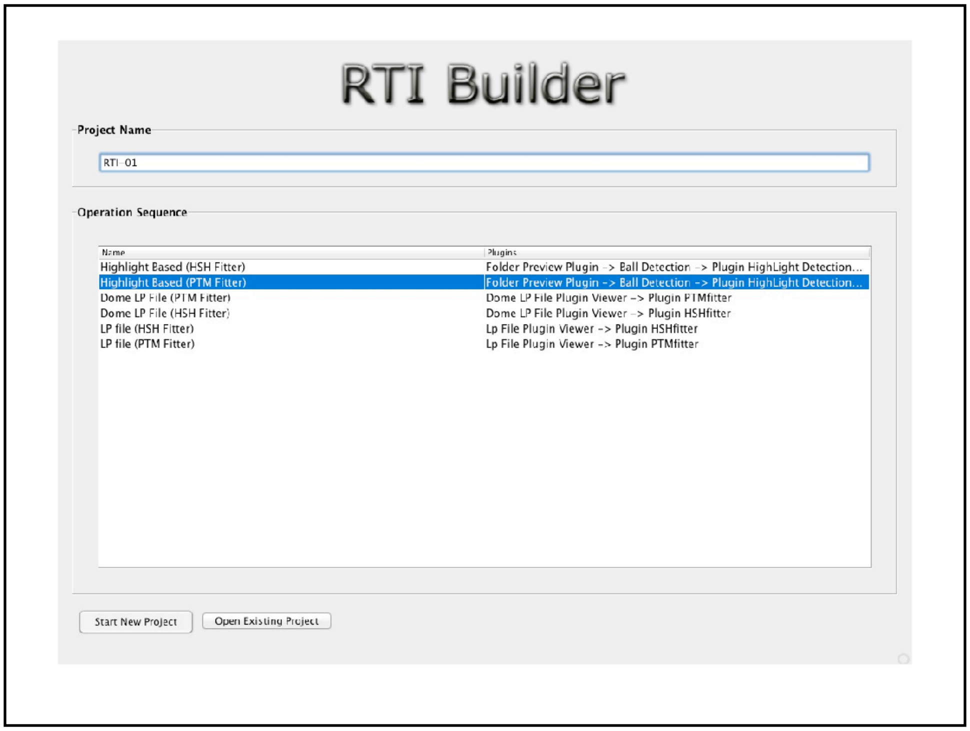


**Slide 19: RTI/Setup – lighting**

This is our setup in the camera room. The Charter is on a flat surface, held unrolled by a set of weights. We have the camera positioned directly above, with a single flash unit that I was able to move around to make each individual shot with a different angle of light. Finally, you'll see a red sphere (or "snooker ball," if we're being technical) in the shot. The snooker ball captures the position of the light in each image through the specular highlight it reflects from the flash. It is this highlight information that will be used to generate the model of the surface, and which we will use to move around the subject and inspect its surface digitally.

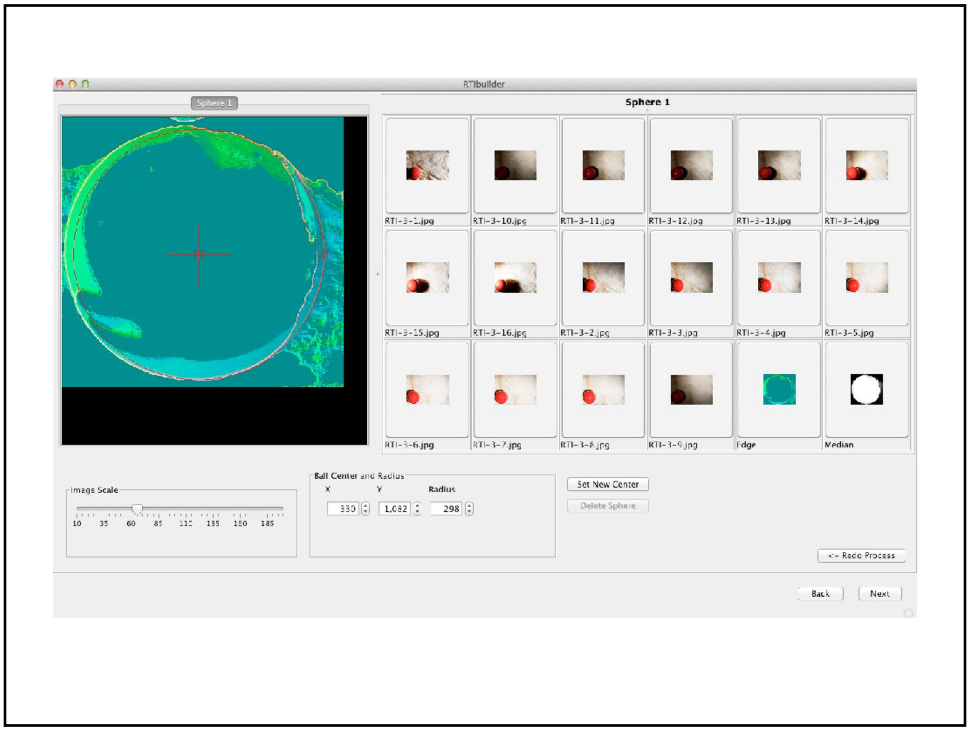
**Slide 20: RTI/Sample Image**

This image is one of approximately 30 shots taken to make the RTI build. The specular highlight is visible in the ball.



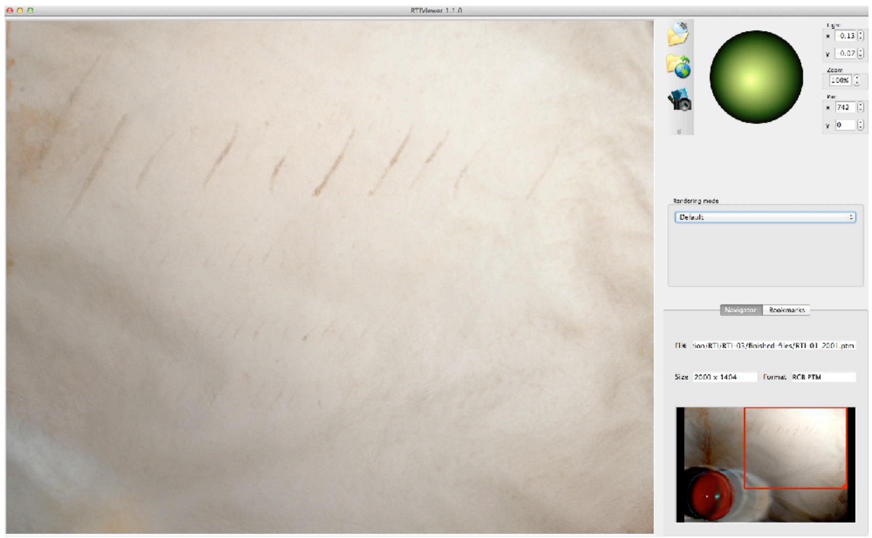

**Slide 21: RTI/View of Build start**

This is the opening page of the RTIBuilder software. You'll see I've chosen Polynomial Texture Mapping over the other options.



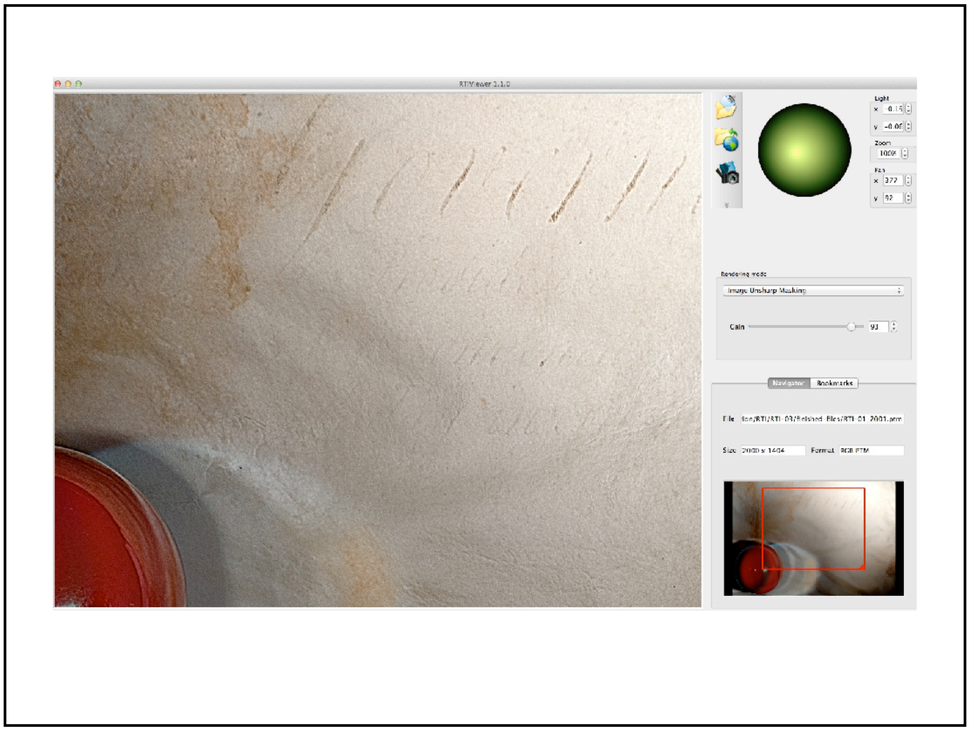

**Slide 22: RTI/Screenshot of  Build view**

This is a screenshot about halfway through the process of creating the .ptm file (the polynomial texture map that RTI Builder outputs). You can see the software is focused here on the sphere that I included. When you import your files, you essentially show the software where to find your sphere (and specify if it's red or black) by drawing a box around it. Then, it automatically detects the outline of the sphere, and the specular highlight reflecting off of it. A visual double-check by the software user confirms for the software that it's correctly identified the sphere and highlight, and it generates the .ptm files that is easily manipulate in the viewer.



**Slide 23: RTI/Screenshot of view**

This is the .ptm file as it's opened in the viewer. There are many drop-down options available for processing the image, and you can see the green sphere in the corner, which allows you to change the direction of the light based on the position of the highlight in the green sphere.

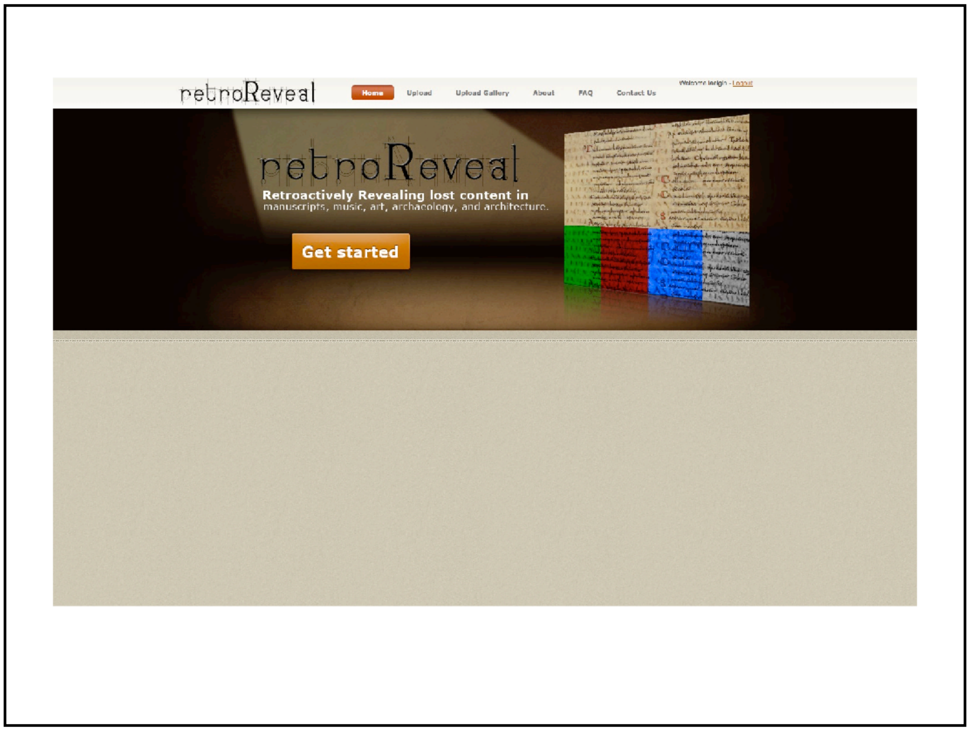


**Slide 24: RTI/Screenshot of view**

And this is one of many views using of the many options for image filters and processing. You can see there's much more information here than we have previously seen. I thought it would be good to open this quickly in the RTI Viewer so you can see how it actually works.

Beyond the Standard Part II:
Cross Polarization

Section 4

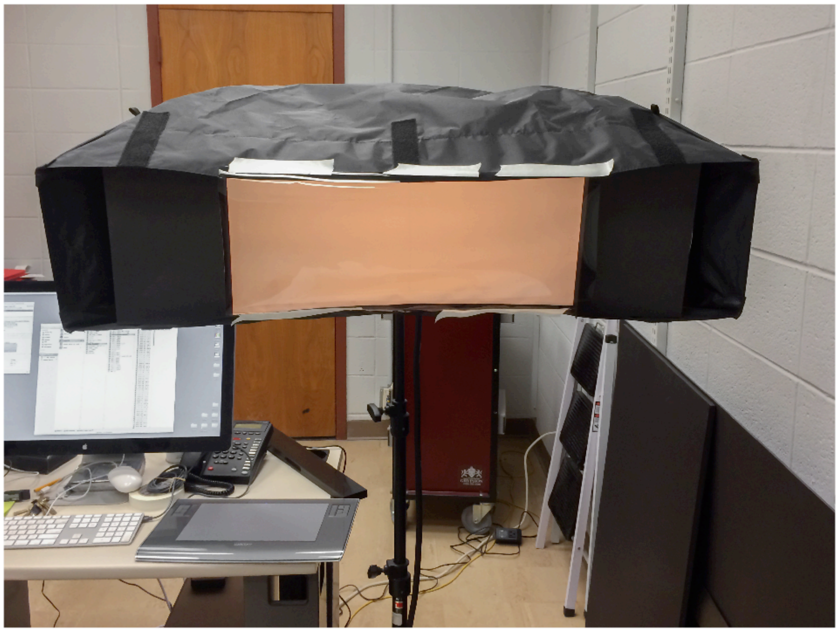



**Slide 26: Retroreveal**

Our next move was to try using a specific image processing website called Retroreveal. I'll go into how it works shortly, but first I want to show you how we produced images that we'd use in Retroreveal. For this type of image process, we had to do a complete 180 and REDUCE reflections as much as possible. The best way to reduce reflections is by using a technical called cross polarization.


**Slide 27: Polarizing filter**

Polarizing filters are a common item in the camera bag of many photographers - both professionals and amateurs. Polarizing filters, which attach to the front of the lens, reduce glare and reflections of many kinds; this includes atmospheric glare, which is why many people use them when shooting landscapes (they also tend to saturate colors without actually altering them). Outside of landscape photography, polarizing filters are used whenever there are unwanted reflections from water, glass, and any glossy surface other than metal.



**Slide 28: CP/Film on light**

You'll notice that I said polarizing filters reduce glare: they do not eliminate it. To remove all specular highlights from an image, a polarizing filter is only half the battle. The first step in cross polarization is actually to polarize the light BEFORE it hits the camera. This is very simple: you need to apply a polarizing film to the lights you're using to illuminate the subject. We used the same lights as we use in the reprographic setup, and ordered polarizing film to attach to the lights. We covered the areas around the lights with black foam or cloth to prevent unpolarized light leak. It was important that we use these lights because a) they're strobes, and hot lights would melt the filters, and b) they're quite strong, important because adding the polarizing filters can reduce your exposure by as much as 75%.

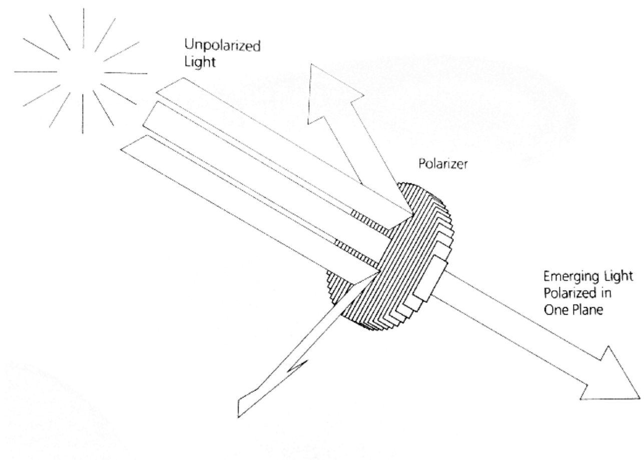
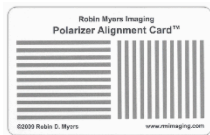



Image Credit: An Ansel Adams Guide, Basic Techniques of Photography
by John P. Schaefer, Little Brown & Co. 1992

**Slide 29: CP Diagram**

So the light that hits the object is polarized, so it is all traveling in one direction (or polarity). This helps reduce glare to begin with, since the object is only being stuck by light at a given amplitude. However, any kind of light striking any kind of object will still produce reflections. By outfitting the lens with a polarizing filter, all reflected light can be absorbed by the filter, completely eliminating any glare from the object. If you look at this diagram of a polarizing filter, think about the waves of light coming out of the strobes becoming polarized (traveling in one direction) and then the ensuing reflections off the subject being subject to a second round of polarization.




**Slide 30: CP/alignment**

One of the most important parts of good cross-polarization is correct alignment of the two polarizing filters. To avoid any incidents, we used a polarizer alignment card, which changes in tonality (the silver stripes go to black) as you get closer to 90˚ which is perfect polarization alignment. Once you're at the proper alignment, the silver strips look black.

**Slide 31: CP/camera room 1**

Here you can see the light covered in polarizing film, and the camera with its polarizing filter (we did have to use several step up rings because of a different in filter size between our lens and our polarizing filter). Notice that we did use again the hot shoe level to ensure that the camera was level with the charter.

**Slide 32: CP/camera room close up**

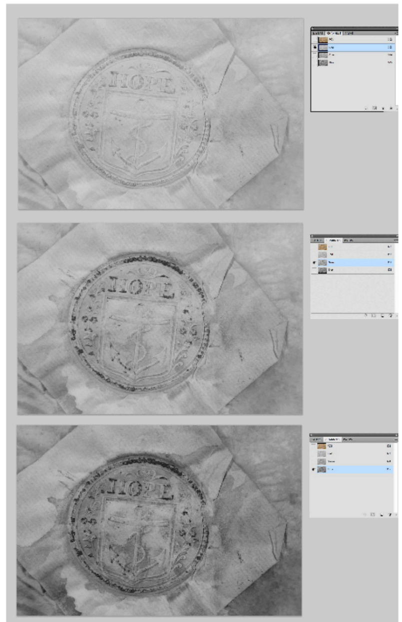
For this set of images, I attached extension tubes to the camera to allow us to focus very close up to the charter.


**Slide 33: Retreoreveal**

Once we found some images we liked, we loaded them into Retroreveal. This free, online resource allows you to upload images of any object, and allow its software to perform operations on the image to bring out details and other image information. The main function of Retroreveal is to transform a regular RGB image into a variety of other color spaces. Using specific algorithms, these transformations produce a wide range of images, which can then be examined for previously unseen, or unviewable, details.


**Slide 34: RBG/main**

Most digital images are captured as RBG images. They may be in Adobe RGB, sRGB, etc. and these terms designate the color space. Color spaces are essentially ways of modeling the colors in an image: correctly representing coca cola red, or hulk green, for instance. In any variety of RGB color space, every pixel of the image is made up of a combination of red, green, and blue. Each image, then, contains three separate channels (one for red, one for green, and one for blue). To the right, you can see the combined, multi-channel image where red, green and blue are combined to produce a full color image.

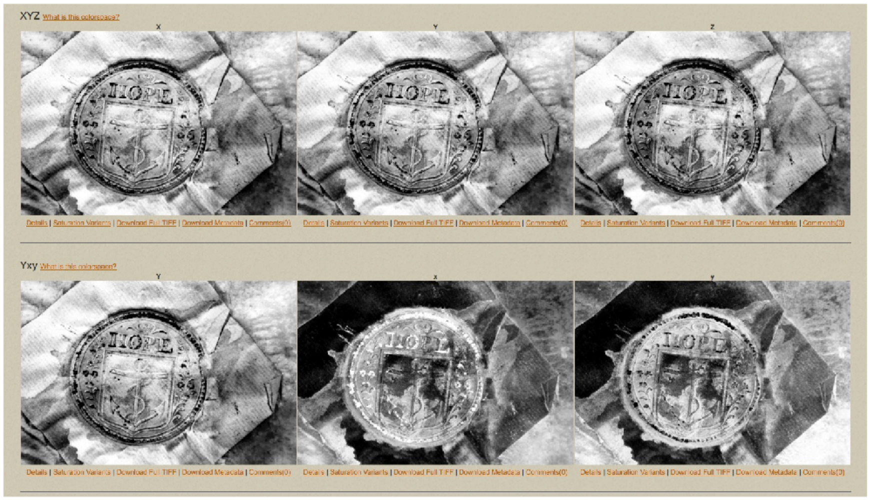


**Slide 35: RBG/Separate channels**

Here you see the each separate channel: they are each monochromatic because they are a map of the amount of each particular color in that channel.

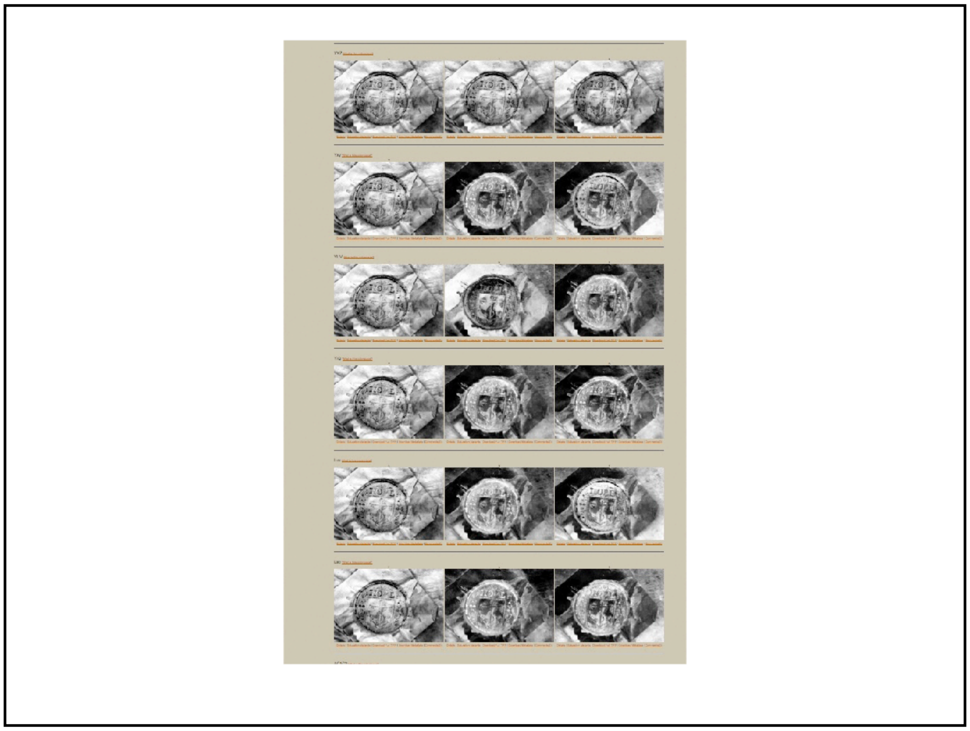

**Slide 36: Retroreveal/image**

Here is the same image, as uploaded onto Retroreveal



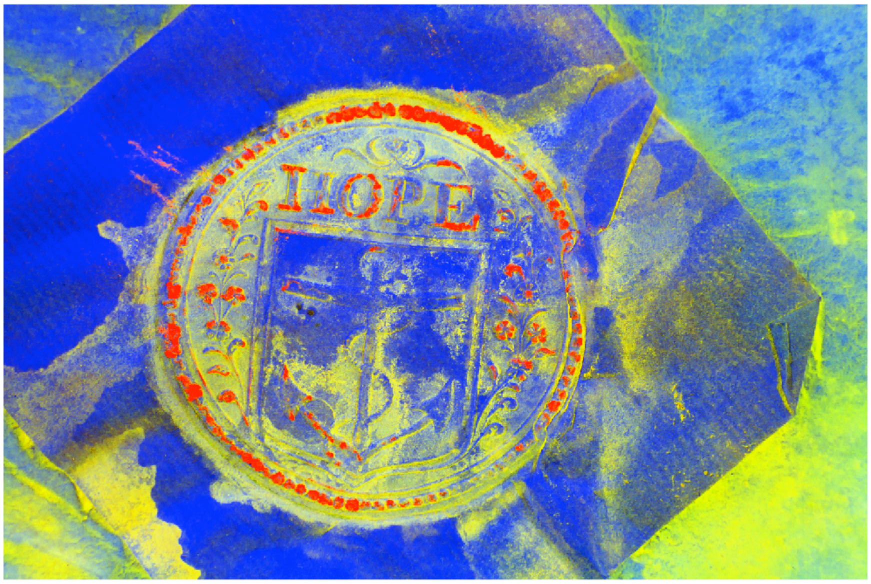

**Slide 37: Retroreveal/channels**

And here we see two different breakdowns of the channels of two different color spaces: XYZ and Yxy.



**Slide 38: Retroreveal/Many channels**

As you can see, though, we have many options to choose from.




**Slide 39: Retroreveal: put channels back together**

And here is an image we created by combining the three channels created by transformation into the Yxy color space.