PINHOLE CAMERAS: POSITIVES AND NEGATIVES

Michael Potter

Figure 1. Michael Potter, ceramic pinhole camera.

In this essay, I will examine the history of the pinhole camera and camera obscura. In particular, I will investigate the types and uses of these cameras and theories about the use of the camera obscura by the seventeenth-century century painter Johannes Vermeer. I will also look at how the pinhole camera has influenced my own studio practice and my use of an historical tool in a modern technological context.

A pinhole camera is simply a light-tight box with a hole in one side, facing a well-lit scene. That scene is then projected onto the opposite side of the box, upside down and inverted left to right. Because light travels only in straight lines, what is at the top of the image travels through the hole and continues in a straight line to the lower edge of the projected scene, and light from the left of the scene travels to the right-hand side of the camera. The term 'camera' makes us think of a portable box, as in twenty first century cameras, but early pinhole cameras were often as large as a room in a house, or assumed a portable form that was tent-like. Although these instruments are called cameras, the technology for permanent and reproducible image capture was not invented until the middle of the nineteenth century, almost simultaneously by Daguerre and Fox-Talbot.[1]

Figure 3. Johannes Vermeer, *The Music Lesson* (c1662-65). Photo credit: http://en.wikipedia.org/wiki/The_Music_Lesson.

The earliest recorded mention of a pinhole camera was as early as the fifth century BC, by the Mohist philosopher Mozi.[2] In 1021, the Arabian scientist Ibn al-Haytham wrote about pinhole effects in the *Book of Optics*. He discovered that by using a smaller pinhole the image appears much sharper, but is also dimmer.[3] Later in the same century, Chinese scientist Shen Kuo was the first to establish geometrical and quantitative attributes for the pinhole camera.[4] In the thirteenth century, the English monk and scientist Roger Bacon described the use of the pinhole camera to observe solar eclipses without damaging the eye.[5] This became one of their major uses.

The first mention of a camera obscura, from the Latin for 'darkened room,' was made in 1604 by German astronomer Johannes Kepler, not long after lenses had been invented for use in microscopes and telescopes in the Netherlands.[6] The use of a lens allowed much more light into the camera obscura and, with a mirror placed at 45 degrees to the rear wall, meant that the image could be projected onto an opaque glass screen on the top side of the camera. This enabled the observer to trace the projected image onto paper placed on the screen. It also meant that, on a larger scale, an artist could sit inside the chamber and draw the image onto paper placed on the back wall, or stand outside the chamber to trace it onto an opaque screen mounted on the rear wall. These types of cameras were widely used as an aid to drawing.

Prior to this, from the 1420s, concave mirrors had been used to reflect an image onto a canvas or paper. It is in this period that a dramatic shift in painting occurred characterised by an increase in realism, particularly the more naturalistic treatment of faces. Perspective also became increasingly accurate, giving what David Hockney called "an optical look" to paintings.[7] Hockney argued that from the 1420s, artists such as Van Eyck, Caravaggio, Velazquez and Vermeer used optical devices such as concave mirrors, camera obscura and camera lucida aids to rendering lifelike images in their paintings.[8] (Camera lucida does not involve the use of a camera, but rather a set of mirrors.) In 2001 Hockney published *Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters*, where in association with physicist Charles Falco he published the results of tests on a series of paintings to establish whether or not optical devices had been used in their creation.[9]

Also in 2001, Philip Steadman published *Vermeer's Camera: Uncovering the Truth Behind the Masterpieces*.[10] In it he examines a number of Vermeer's paintings and explores repeated elements in several paintings and the use of viewpoints that might point to the use of a camera obscura. Steadman goes to great lengths to establish the size of the room in which the scenes he studies were set, and is able to measure with some accuracy the size of the original floor tiles as well as the maps that hang on the walls in the background of several paintings. The original maps used by the artist have been located in museums, and Vermeer's versions show very accurate reproduction of detail and correspondence in size when compared to the maps in the paintings.[11] Furthermore, the sizes of six of Vermeer's canvases were predicted to a high level of accuracy by Steadman's camera obscura hypothesis.[12]

However, this approach proved to be highly controversial, and Hockney in particular experienced quite a backlash from the art world. Some art historians and artists were not prepared to admit that the Old Masters used a technique that is considered by many as cheating, at least as far as drafting a painting is concerned. Many people with

Figure 4. Michael Potter, circular ceramic pinhole camera.

a vested interest in maintaining the credibility of the art world were unwilling to see the reputation of some of the world's most famous artists undermined. However, many art experts have been concerned to refute the arguments put forward against the use of optics in these paintings.

Personally, I do not have a problem with artists using optics as an aid to painting. It stands to reason that a successful artist in a competitive market would use new technology to create a new style or enhance realism in order to gain an advantage over the competition, or purely out of interest. In any case, the use of a camera obscura or pinhole camera is limited to the laying out of initial drawings. The skill of these artists as painters was never questioned by Hockney or Steadman; as Hockney put it, "Optics don't make marks."[13] Painters like Vermeer are held in high esteem today because of their ability to paint light. Just because I can use a camera obscura does not mean I would be able to paint remotely as well as an Old Master! However, these investigations have definitely shed light on techniques that may have been employed by the artists involved.

My research into the historical use of pinhole cameras came about through my own attempts at making pinhole cameras and my former profession as a photographer. As part of my degree project, I chose to make a series of ceramic pinhole cameras for the studio practice component of my final-year project, using traditional black-and-white darkroom techniques to produce photographs with them. It goes without saying that my abilities as a photographer far outweigh my abilities as a painter!

In the past, I have made pinhole cameras out of cake tins, shoeboxes, wooden boxes and homebrew beer cans. Using ceramics as the material for the cameras brought with it its own history, particularly in relation to the vessel and its function of containment. Pinhole cameras need only to contain a sheet of photographic paper to become functional. Their purpose is to exclude all light, except during exposure, after which they contain a latent image on the paper, the negative. There is a certain mystery about their contents, as they need only be opened for material to be placed inside and removed in a darkroom. There is a functional, domestic feeling about these cameras, with

all of them seemingly at home in the home. I have sought to raise questions about their exact purpose by additions that hint at the sculptural, but remain within the realm of the domestic.

My first ceramic camera was made in the shape of a biscuit tin (see Figure 4). The idea was to make a camera that can take a 360° panorama, comprising four images taken from four pinholes positioned at 90° to each other around the circular body. As this camera has no front or back, I had to devise a system for holding the photographic paper in place. Attached to the underside of the lid is a tube that the paper is wrapped around; being removable, the lid also helps to attach the paper.

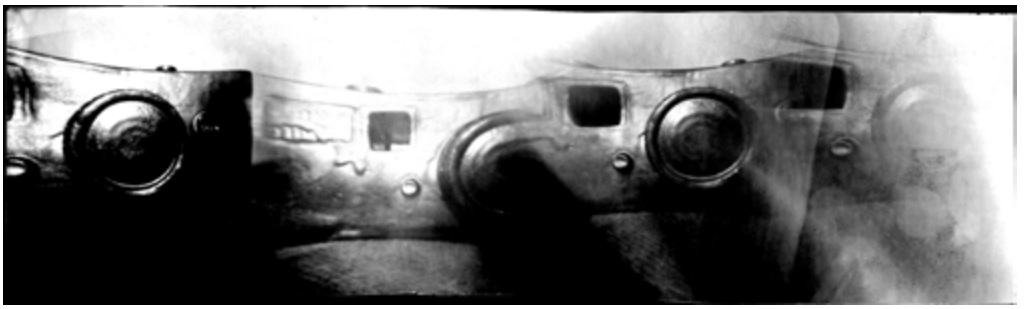

Figure 5. Michael Potter, photograph taken with circular pinhole camera. The camera was rotated to take four shots of the same subject, in this instance another ceramic camera.

Figure 6. Michael Potter, photograph of Mapua channel taken with a concave back pinhole camera.

My hope was that each lens would expose one quarter of the paper inserted, and therefore create a panoramic image that merged one scene into the next, with horizons that bent in towards each other near the centre of the image, as in Figure 5. The horizon lines are distorted due to the paper sitting on a convex surface. This particular camera had two main uses: taking four shots of the same scene by turning the camera around on its turntable bearing, and taking 360° panoramas. For most of my ceramic cameras, I have used local ash glazes fired to cone 10 in reduction. This is the opposite of the effect one would expect in a biscuit tin – very drippy, with bare patches and rough textures from the seaweed glaze (as seen in Figure 4).

The next ceramic camera I made (Figure 1) had a concave focal plane where the paper sits. This produces an image with horizons that curve out towards the top and bottom of the image. The result is a very panoramic view, almost a fish-eye lens look. This is great for landscapes – it feels like the landscape is coming towards you and you feel very much at the centre of the scene (Figure 6).

Figure 7. Michael Potter, decal applied to ceramic tile. Photograph of an Udu drum taken with a ceramic pinhole camera.

For this camera, I devised a lid with an additional rim set about a centimetre in from the outside wall; this rim acts as a light trap when it sits over the raised rim of the camera body. This camera has a very organic shape, with a smooth apple ash glaze complemented by a small scallop shell fitted as a 'lens cap' – all the cameras need something to cover the pinhole before and after exposure. The pinhole itself is in a piece of tin can glued to the inside of the camera. I have solved the problem of holding the cap in place by using magnets glued to the back of the cap that stick fast to the tin pinhole shim. Traditionally, black masking tape is used for the cap and also around the opening.

The second part of my project involved converting the images I had taken with these cameras into ceramic decals that were then fired onto ceramic picture frames. Once the negative is developed, it is scanned and inverted into a positive image that is ready to print. Decals have a long history in ceramics going back to the Industrial Revolution, and have often been used for mass-produced domestic ware, replacing intricate and time-consuming hand painting of images on a large scale. With a laser printer I can print my own graphics directly onto water-slide decal paper. The image is cut to size and soaked in water and then slid off the backing paper onto the fired piece. The image fires to a sepia colour as the ink in the printer contains iron oxide. Generally the decal is fired on top of a glazed area so that the iron oxide can melt into it.

I am also testing placing these images on bisque ware and onto green ware, both of which are giving interesting results due to the lack of adhesion in the firing stage. My 'picture frames' for displaying the photographs are white clay slab, representing traditional paper, rolled onto a heavily grogged dark chocolate brown clay that functions as the 'frame.' I am also testing thin white clay slabs with naturally curving edges that lead the viewer to assume that the image is on paper. I have applied this technique to my domestic ware with good results.

A very sharp image is obtainable from pinhole cameras constructed with laser-drilled pinholes set in brass shims and using very long exposures. However, I prefer the high-contrast images with softer edges that result from my use of handmade shims. For me, the slightly dreamy, otherworldly and distorted images produced in this way is what makes using these simple cameras such a pleasure.

Today, we have any number of devices that capture very high quality images that can be sent around the world in an instant. By contrast, the pinhole camera is the ultimate in slow photography. It is hands-on, needs a darkroom, and takes only one photo at a time – and the resulting image is usually not what you were expecting. It is all about slowing the creative process down, having time to think and to compose a shot and savouring the darkroom experience as you watch the image develop in the tray. Quite often I find that surprise, delight and disappointment are all swirling around at the same time.

This essay has brought together two passions and two careers for me, photography and pottery. When I started to combine the two, I was sent in a direction that I had not planned but that now seems very natural, with exciting possibilities. Researching the pinhole camera has given me a new perspective on the history of optics and image-making and has shown me a new way in which to view historical paintings. Using my own photographic images as decoration links me with the history of printing on ceramics, but in an even more direct way. By taking this approach, and using the latest technology available to me to convert and print the original negative, I am possibly imitating the Old Masters who had recourse to the camera obscura.

Michael Potter has completed the Diploma in Ceramic Arts programme by distance at the Dunedin School of Art at Otago Polytechnic. His pinhole camera was selected for "Best in Show" at Objectspace in 2015.

1 http://en.wikipedia.org/wiki/Pinhole_camera [accessed 2 Aug 2014].

2 Ibid.

3 Ibid.

4 Ibid.

5 *The Camera Obscura in History*, http://www.obscurajournal.com/history.php [accessed 10 Aug 2014].

6 *Art Optics: New Theories of Opticality in Western Painting of the Past 600 Years*, http://hockney-optics.brandeis.edu/introduction/index.php [accessed 10 Aug 2014].

7 Ibid.

8 Philip Steadman, *Vermeer and the Camera Obscura* (2011), http://www.bbc.co.uk/history/british/empire_seapower/vermeer_camera_01.shtml [accessed 10 Aug 2014].

9 David Hockney, *Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters* (New York: Viking, 2001).

10 Philip Steadman, *Vermeer's Camera: Uncovering the Truth Behind the Masterpieces* (Oxford: Oxford University Press, 2001).

11 *Art Optics*.

12 Ibid.

13 Steadman, *Vermeer and the Camera Obscura*.