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## **Introduction: Photography in the context of skill**

Photography in the broadest sense is the intentional gathering of photons onto a substrate to form a permanent image. It is considered by many to be a visual art and has applications in many industries, from taking images of fashion models on the runway to skid marks at a traffic accident. From general experience, one can see the many applications of the camera as a tool. It records images for the purpose of conveying information. The consumer level point-and-shoot camera records pictures of family outings, parties with friends, scenic landscapes. The telephoto lens professional digital camera captures front-page images of athletes sprinting across finish lines, politicians waving at crowds, and celebrities walking down city streets. The satellite-mounted camera takes detailed images of the Earth's surface.

In the context of this course, we can view the camera as a tool manipulated by humans to produce an image. The image is a commodity with different value to different viewers based on its content and on the technique used to capture it. For example, Dorothea Lange's photograph, *Migrant Mother, Nipomo, California*, has become an iconic image of the Great Depression in the United States. The skill required of the photographer was in her evaluation of an interesting subject, her judgement of how much light she allowed to fall on her film (or plate), her choices in the darkroom of what processes to use to develop and print her image, and her use of the image to convey an idea or concept. With this in mind, her work to create this image could be viewed not as art or craft or science, but overall as skilled practice.

In this paper, we inspect the early development of tools to improve image recording for the purpose of conveying information about the known world and its phenomena and analyze a few cases where the image produced by a photographer had value to individuals and society as much for the method of its creation as for its content. We can ultimately relate these types of

images to Gell's idea of the technology of enchantment and the enchantment of technology and on how these specialized techniques relate to the ideas of habitus and embodied knowledge.

### **Argument: Photography as Skilled Practice**

Looking back in history from 2013, it can be claimed that photography has indeed changed human perception of reality differently than other forms of information transfer. For viewers of these photographs, their impact is in their subject matter, in what they convey. Photojournalism has recorded the human condition from the piles of slain soldiers on Civil War battlefields to Germans smashing down the Berlin Wall. Photographs bring information from faraway places to educate, influence, and inspire viewers, whether it be Ansel Adams taking images of the American frontier or William Anders taking a picture of Earth rising over the horizon of the Moon.

Although much of the value of the image is in its content, there is also value in its realistic portrayal of subjects which consistently exceeds that of paintings and prints, which reflects on the ability, knowledge, and therefore skill, of the photographer to produce an image that can be instantly appreciated as a representation of the natural world. Elements such as sharpness of focus, contrast, motion blur, saturation, although they may not be identifiable by these names to a viewer, are the variables a photographer adjusts to produce her intended image. The tools she uses are the camera itself, the substrate, film or plate or paper or CCD chip, the chemicals for developing or the software for processing, and the equipment and chemicals and paper for enlarging and printing negatives.

Although a photographer can know as little about technique as a thirteen-year-old with an iPhone and Instagram or as much as George Eastman, the founder of Kodak, she relies on the

same system of distributed knowledge of the technologies surrounding the camera and image production. Neither profound understanding of gelatin film deposition and silver nitrate chemistry nor deep knowledge of optics is required to take photographs—the knowledge is embodied in the tools the photographer uses. Of course, a photographer interested in a fine degree of control in image production could learn how to do wet plate photography and mix her own emulsions, but modern film has replaced these old processes, supplanting need for one set of skills and tools to produce an image with a new tool to simplify the process and new skills required to use this tool (Feibleman).

As cameras have become more and more complex, the user has had to know less and less about how the image is formed, i.e. the teenager with an Instagram, and at some level, the user cannot possibly expect to completely understand all the processes that come together to create an image. The image making cannot be completely automated, even at the most advanced digital scale. It requires a human to press the shutter or run the program script. Human discernment and decision-making is still required to produce an image of value, and in this space, however advanced the surrounding technologies may seem, we can examine and apply anthropological ideas of craft, skill, art, and science.

Starting most noticeably with the works of Renaissance painters, followed by the realistic genre paintings of the Dutch masters, creating accurate images of what the eye perceives has long been a major focus of the visual arts in the Western world. With that aim, artists developed technologies to assist them in this effort. The camera obscura, the “darkened chamber,” was one such technology, known to scholars and thinkers across the globe. A small aperture allowed light to enter a darkened booth or room and projected an image of the outside world onto a flat surface such as a wall or a pane of ground glass. Designs were sized down to make camera obscuras that

projected outside images into a box and then reflected them onto a viewing window onto which a user could place a sheet of paper and accurately trace what was being viewed. This design of the camera obscura is what art historians hypothesize Dutch painters such as Johannes Vermeer used to create their paintings (Steadman).

The earliest cameras progressed from this earliest tool to capture and manipulate light. Inventors borrowed from other developments in optics and modified the work of their predecessors, a body of distributed knowledge (Dormer) that provided the technologies they needed to create new tools. For example, at about the time of the 17th century, the convex lens in optics was still a new concept and although inventors who required lenses for their devices would often grind their own, many still relied on other individuals who made lens-making and mirror-grinding their specialized trade (Steadman).

The purpose of the camera obscura was to accurately capture and reproduce scenes of the real world or of other detailed works, such as maps. Steadman observes in his analysis of the use of the camera obscura by Johannes Vermeer that many of his paintings depict maps hung on walls copied with a high degree of accuracy from actual maps found among Vermeer's possessions. Using the language of David Pye as referred to by Peter Dormer, we can say that these artists were attempting to change image capture from a workmanship of risk to a workmanship of certainty.

There are many challenges an artist faces in painting a scene or reproducing a map, measurements of scale, depth, and perspective and choices of color, light and shadow, that need to be made. These choices rely strongly on the artist's tacit knowledge of how to observe and draw her surroundings, acquired through many hours of practice and guidance from instructors

and other artists (Dormer). The artist seeking to make an accurate representation has a laborious task in transmitting this information from the eye to the page.

With the implementation of the camera obscura, the artist has a tool to more faithfully reproduce this information, a tool with the capacity to flatten a three-dimensional scene into two dimensions and project it onto a surface where it can then be traced comfortably by the user. Aside from some changes in proportion of the subjects due to the use of the lens in the camera obscura (Steadman), this tool could certainly qualify as a technology that allowed life-like image reproduction to become a workmanship of certainty.

From the camera obscura and many experiments in light-sensitive chemistry came the daguerreotype and other early forms of permanently etching an image into a substrate. The daguerreotype used the formation of photosensitive silver iodide, developing with mercury, and fixing with salts to form a positive image of an object. The response to the technique was mixed, as some observed that it far surpassed the detail painters could capture in an image and would put them out of business while others saw that a user of this technique did not need be skilled in painting or drawing to accurately capture images (Leggat). This can be seen as an example of proficiency in one skill supplanting proficiency in another (Feibleman). The habitus of the artist (O'Connor), the muscle memory of a hand manipulating a pencil over paper, the subconscious sensory response to changes in paint and ink and canvas, was now distinct from the tweaking of the controls of a camera, the numerous adjustments in response to changing conditions of light, chemistry, and other factors, that came unconsciously to the experienced photographer.

In comparison to the many hours of practice and instruction required to be a proficient painter or printmaker, the relative ease of making photographic images increased the demand for development of this technology. Photography expanded through the 19th and 20th century, the

image-capturing substrate progressing from the daguerreotype plate and albumen-coated paper to the wet processing plate to the dry gelatin plate to rolled-up film. The camera itself became smaller, more portable and more reliant on mechanisms rather than manual operation.

## **Analysis: The Technological Magic of Edgerton, Abbot, and the Hubble Space Telescope**

High-speed photography has fascinated photographers since the earliest days of photography. An early and notable example is Edward Muybridge, who, in 1878, used an array of twenty-four cameras and a trigger mechanism to photograph running horses at a racetrack. His photographs demonstrated that the movement of horses was fundamentally different from how humans had perceived and portrayed it. Although others were also experimenting with high-speed motion photography, his work is one of the most notable examples of photography changing human perception (Leslie).

His photographs of the running horse, all four hooves off the ground, connect naturally to the work of Harold “Doc” Edgerton. Edgerton, beginning in the 1930s, used standard camera equipment and bright, brief flashes of light from stroboscopes to “freeze” fast-moving processes, starting with the rotation of motors. These images improved scientific understanding of many high-speed processes and shared their striking and novel aesthetic with many viewers.

Edgerton’s area of expertise was in electrical engineering, but when he realized the power of the stroboscopic technique, he began exploring its possibilities in collaboration with many other engineers and photographers. He developed most of the equipment he used for his photographs and movies himself, modifying existing film cameras for high-speed movies and

designing his own controllable stroboscope to produce consistently spaced flashes of light with circuitry to control light intensity and interval spacing (Killian).

The images and movies produced by the EG&G laboratory are indeed visually striking. These images reveal much about the natural world, but also have the same effect as a magic show or sleight-of-hand trick, a response from the viewer of, “How’d he do that?” Once explained simply, the “illusion” is understood, but the sense of wonder remains. Like the intricately-carved canoe boards Alfred Gell describes in his essay, the influence of the images is in the “magical power” of the photographer to capture such a unique and otherwise invisible image.

In the short film, *Quicker than a Wink*, many beautiful examples are demonstrated, such as swirling eddies of smoke rolling off rotating fan blades and coronets of droplets formed by milk dripping onto a dish. Gjon Mili, Edgerton’s collaborator, sought to exploit this sense of wonder to freeze motion of dancers and singers, his focus more on the artistic elements than Edgerton’s on the technical (Killian). However, the application of this technology also led to better understanding of scientific phenomena that could not be seen with the naked eye at normal speed. Still images of bullets in silhouette revealed the propagation of shock-waves as the bullet traveled through the air (Killian). The wings of the hummingbird, usually a blur of motion, were slowed down to individual flaps and the speed of wingbeats measured. The intriguing question of how a cat laps up milk or a dog drinks water was answered through recording the motion in a high-speed movie (Smith).

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Berenice Abbott, a female photographer active at the same time as Edgerton, sought to bring science to the world through photography, a format that she knew from experience was

instantly and easily understandable. “[Science] needs to speak to the people in terms they will understand. They can understand photography preeminently.” Her manifesto on photography and science called for “a friendly interpreter between science and the layman,” which she believed was exclusively photography. “For photography, the art of our time, the mechanical, scientific medium which matches the pace and character of our era is attuned to the function. There is an essential unity between photography, science’s child, and science, the parent.” (Kurtz)

As has been discussed above, the development of photography relied heavily on concurrent progress in science. Abbott’s experience as a photographer had been cultural, “documenting New York City.” She felt strongly that her perspective as an artist was needed to photograph science. “The artist through history has been the spokesman and conservator of human and spiritual energies and ideas. Today science needs its voice. It needs the vivification of the visual image, the warm human quality of imagination added to its austere and stern disciplines.” (Kurtz)

Her images of scientific subjects relied on a form of what Peter Dormer calls “middle-aged knowledge.” She was well-experienced in photography by the time her interest turned to science and had published a book of images of New York City, *Changing New York*. She relied on this body of practical knowledge to develop the techniques that would capture her new intended subjects. Although she consulted Harold Edgerton when producing some of her images that relied on strobe photography, such as paths of pendulums and bouncing balls and falling masses (Kurtz), many of the methods she used she developed herself, most notably the table she used for creating her wave images and the technique of macro-photography, which she kept secret for many years. She kept meticulous notes of her work and how it was produced and approached the task of accurately conveying concepts in physics with rigor and care.

Viewing her images of patterns of rippling water or iron filings aligned along magnetic field lines or the paths of light through curved lenses evokes in the viewer a sense of awe in the natural world, in the patterns of physical phenomena Abbott shows in their purest form. These are not just abstract lines or mysterious shapes. Her work takes care to include the equipment that makes the image possible, “the homely little devices the scientists come up with for my experiments.” (Kurtz) In this way, we see beauty in how the image is made, in the technology that it photographs and the technology that allows it to be photographed. There is value in the intellectual possession of understanding the technical process of how it came into being, the “magic” of the image (Gell).

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A digital revolution away from the film-based techniques of Abbott and Edgerton, but evoking the same amount of awe and wonder are the Hubble Space Telescope (HST) images which have changed the way the world perceives the rest of the universe since 1993. The telescope orbits around the Earth and brings together knowledge and expertise from all sides of science and engineering. Used to take astronomical images in the near-UV, visible, and infrared wavelengths, the telescope represents a significant milestone in camera technology. The images from the HST of stars, planets, and nebulae fulfill Berenice’s Abbott’s goal of bringing science to the public in an accessible form, through photographs, and much popular interest in astronomy and space has been garnered through their publication. Nebulae that look like chickens or tarantulas or horseheads, although invisible to the naked eye in an ordinary night sky, have become part of the public consciousness and the common knowledge of what outer space contains.

The production of these images nowhere has a human hand pressing a shutter or developing a roll of film. The HST is orbiting above Earth and can only be serviced by astronauts. There is, however, a human, actually many humans, in charge of the selection of targets and the processing of the digital images sent back from the space telescope. The targets are in fact chosen for science purposes and the data is used by astronomers seeking to make precise, accurate measurements of the behavior of objects in space. However, many of these images can be presented to non-astronomers as snapshots of the universe, providing perspective on where Earth belongs on that scale.

Villard and Zolta describe how the images are made. First, several images of the same subject are taken through various filters mounted inside the telescope. The filters allow only light of certain wavelengths to fall on the camera. Effects from cosmic rays striking the CCD (charge-coupled device) and saturating a pixel are removed through image comparison. Baseline and maximum saturation levels are established. At this point, the images are still not in color. Each step in intensity of the light which fell on a pixel of the CCD is assigned a grayscale value. The scaling of these values is changed to allow for midtones to have the widest range of values. From there, the images taken with different filters are assigned a color based on which wavelengths they blocked, and the images are combined to make a composite image. The colors assigned sometimes are consistent with the actual color of the planets or stars they depict, but are sometimes assigned “false” coloring that better shows changes in tone of an object. This process is the standard image reduction for any astrophotographer, but the HST images are unique because of the clarity and range of wavelengths available from the camera’s position in outer space.

There is a great deal of knowledge of digital image processing that goes into creating these images which combines standard topics that carry over from conventional film and digital photography as well as topics specific to photography using large CCDs that are operated in space. Because the images are taken primarily for science, their subject matter is purely representational, lacking any intentional compositional structure other than putting the object in question at the center of the frame. The incorrect assumption often is that the images seen are exactly what came through the telescope. Therefore, although the images released for popular science purposes create a strong viewer reaction, i.e. a reverence for science, the human hand in the work is invisible and anonymous. Perhaps, then, in this case, the person at the computer has become a new form of artisan, a nameless worker creating art objects for the greater benefit of society, but without visible traces of her presence in the work.

### **Conclusion: Objects of Skilled Practice, Objects of Wonder**

We see that these photographs viewed as art objects, are outstanding examples of Gell's "technology of enchantment," bringing new perspectives to the human view of natural physical phenomena on the day-to-day, macroscopic, and microscopic scale. The subject matter of these images serves a purpose to scientists and scholars, but inspires and informs all viewers.

However, there is value ascribed to these images also because of how they were made and the beauty and difficulty of that making. They hold some innate magic in their realism, their detail, their color, in the mystery of their creation (Gell).

A judgment can be made about the culture in which they were produced, that individuals in that culture have the means to understand physical phenomena and use its technological developments to reach that understanding. The images themselves are neither exclusively

technology nor exclusively art. There is no essential-to-life adaptation to the environment they fulfill, nor are they the work of an individual, a by-product of culture (Ingold). They use technology, they provide cultural value, but they are better described as skilled practice.

The images from these three examples require a great deal of technical expertise and equipment to produce. We cannot easily draw parallels between the embodied knowledge acquired by a glassblower (O'Connor) and that of the photographers described above. However, we can say that in the most abstract sense, glassblowing and photography are both consistent with developing proficiency in any skilled practice. There is a reliance on the knowledge of others which cannot be written down, only conveyed through demonstration and instruction and possessed in innate "personal know-how," but also on the knowledge condensed into the tools used, a shorthand for another body of knowledge this tool allows a user to take advantage of with application of new skills. There is a need for time to be spent with the tools used, to build a habit of practice and hone the senses as a source of knowledge (Feibleman).

Through trial and error, repetition and quantification, the maker can develop a habitus (O'Connor) that allows for constant adjustment during the making of a craft object to bring it each time closer to the mental picture of what it should be, the intended design (Ingold). Sometimes, the goblet comes out misshapen (O'Connor) or the flash of the strobe lamp is not on long enough to capture the full swing of the pendulum (Kurtz), but each trial teaches the maker something, adding to their embodied knowledge.

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