December 2017

The Spider: Anaylsis of an Automaton

Susannah N. Munson
Southern Illinois University Carbondale, smunson@siu.edu

In 2017, the Spider automaton sits in the *Robots* exhibition at the Science Museum in London, surrounded by dozens of other automata. This little clockwork spider is small and relatively unassuming but it, like other physical objects, is a document of an inconceivable amount of information – about itself, its history and associations, and its role in broader social and cultural contexts (Gorichanaz and Latham, 2016). It is the goal of this paper to investigate the Spider and other similar automata as documents using the analytical framework of document phenomenology as laid out by Gorichanaz and Latham (2016). This type of holistic analysis allows the examination of the purpose, contexts, and perception of the Spider and other automata and how those have transformed over their existence.

Document phenomenology (Gorichanaz and Latham, 2016) is an analytical framework in which one can conceptualize documents while taking into consideration the many ways that documents exist, are used, and are studied. It has been recognized that examining documents with respect to their social and sensory aspects gives us a fuller understanding of that document. Not only can we study it through its physical properties and component parts, but we can also investigate how the document was temporally and spatially situated and the ways it *mattered* to the social world in which it existed (Classen, 2007; Gorichanaz and Latham, 2016).

Document phenomenology is conceived in two acts. Act One deals with documental becoming – the convergence of a document's physical and contextual (intrinsic and extrinsic) information with the meaning ascribed to the document by a human actor. During the human-object transaction, a person gives their own meanings to the document through the filters of their mental state and experience (abtrinsic and adtrinsic). Act Two examines the object-document through frames of documental being: Frame 1, the document as a whole; Frame 2, individual parts of the document; and Frame 3, systems in which the document existed and exists (Gorichanaz and Latham, 2016). The intention of this paper is to explore the Spider as a document through Act Two.

A Brief History of Automata

The Spider (see Figure 1.) is an *automaton* (pl. *automata*), a self-moving, mechanical device. The word automaton is derived from the Greek *automatos*, meaning, "acting of itself." This broad definition has historically included an extremely wide variety of mechanized objects including astronomical equipment, clocks, fountains, automated lathes and looms, defensive systems, and animated figures of humans and animals (Reilly, 2011).

The first known automaton was created by Archytas of Tarentum (c. 400-350 BCE), a Pythagorean philosopher, mathematic, and mechanic. Archytas'

wooden, pneumatic dove only worked once; it completed a 200-yard flight and never flew again (Reilly, 2011). Between Archytas' first automaton and the Middle Ages, the production of automata flourished in the Byzantine and Islamic worlds. At this time, the majority of Christian Europe had never seen such automated devices, but accounts from pilgrims, travelers, and merchants, in addition to the travel journals and romances of the Middle Ages were filled with descriptions of marvelous mechanical devices. On rare occasions, a merchant might return from travels with such wonders (Daston and Park, 2001).

The earliest automata were powered by hydraulics, pneumatics, and falling weights, but in the Middle Ages, air and water were replaced by the spring and clockwork. By the late 13th century, English church records began to list *horologia* on records and inventories. In this context, *horologia* has been understood as artifacts that use clockwork mechanisms for movement (Vincent, 2015). In England at this time, these objects would have primarily been clocks and astronomical instruments. The advent of clockwork movement belies a shift in technology that not only made possible the eventual rise of the automaton in Europe, but was also a major step in the technological evolution (discussed in Frame 3) which led to the modern fields of robotics and artificial intelligence (Bedini, 1964; Riskin, 2003). The progress of clockwork technology and the revival of Greek ideas of mechanicism in the 13th century coincided with the translation of ancient Byzantine and Islamic texts which described the engineering behind their celebrated automata. For the first time, the secrets of ancient pneumatic and hydraulic automata became accessible to Europeans. The influence of this convergence of knowledge, technology, and philosophy on scientific thought created a fertile environment that resulted in the eventual creative explosion of automata in Renaissance Europe (Bedini, 1964; Daston and Park, 2001).

Document Analysis: Document Phenomenology, Act Two

Frame 1: the Spider as document

Though the Spider will be analyzed using the framework of Act Two, it is important to note that Act One and Act Two are not mutually exclusive. Whereas Act Two analyzes how an object *exists* as a document ("documental being"), Act One examines how an object *becomes* a document (Gorichanaz and Latham, 2016). Act Two thus compels Act One, as the analysis of documental being necessitates that the object in question is, in fact, a document. If the object is understood to be a document, then the framework of Act One applies to in insofar as the recognition that all documents contain intrinsic, extrinsic, adtrinsic, and abtrinsic information. Intrinsic and extrinsic information are derived from the object-document itself and include the physical [intrinsic] and attributed [extrinsic] properties. When a human interacts with the document, they provide the abtrinsic and adtrinsic information.

DOI: 10.35492/docam/4/2/1

The document beholder's physiological and psychological state [abtrinsic] along with the filter of their personal experiences and associations [adtrinsic] take the information gathered from the document to create *meaning* in the document (Gorichanaz and Latham, 2016).

Similarly, the frames within Act Two are not mutually exclusive; documents exist in all three frames simultaneously. The frames provide an analytical boundary within which the document can be considered, but the relationships between the document, its parts, and the systems in which it exists are overlapping and co-occurring (Gorichanaz and Latham, 2016).

The life of the Spider

Frame 1 investigates the document in its entirety and it is within this frame that the Spider's physical characteristics as well as its life history are revealed. The most immediately observable fact about the Spider is that it is shaped, perhaps unsurprisingly, like a spider. This arguably makes this automaton, first and foremost, a document of an actual spider. It has a rounded, slightly pointed abdomen and eight long, thin legs. The body is comprised of top and bottom halves that fit together, and the head of the Spider is topped by two small, forward-facing, crescent-shaped "horns." In comparison to many of the automata discussed in the literature, the Spider is very small, measuring 2.6 cm long and 3.2 cm wide. The body and internal clockwork is composed of iron and steel and areas of the body surface and "horns" are covered with fire-gilded brass ("Machine," n.d.).

Tobias Reichel, the court watchmaker to Elector Christian II of Saxony (1583-1611) created the Spider in Dresden, Germany c. 1604 for the wife of the Elector, Hedwig of Denmark (1581-1641). The Spider's original function was as an amusement and was it was thus given to Hedwig within the first two years of her marriage to Christian II (Endt-Jones, 2015; "Machine," n.d.). The internal clockwork can be wound (I was unable to find winding information), subsequently raising and lowering the legs and moving the Spider forward. Because the clockwork is inside the body of the Spider, it is free to move forward through space, something that appears was not the case for many historical automata which were often built on cabinets or other bases that hid their inner mechanics (Vincent, 2015). Contemporaneous automata are still operable, but none of my sources specified whether or not the Spider can still be wound up to move.

The Spider and other automata in early collections

When the Spider was given to Hedwig of Denmark in the early 17th century, it likely became part of a cabinet of curiosities. Cabinets of curiosities were collections comprised of antiquities, art, precious materials, ethnographic pieces, natural specimens, relics, artificial curiosities, and other wonders and marvels. It took

considerable time and expense to create these collections due to the typically exotic, rare, or otherwise valuable nature of their contents. Because of this, cabinets were the pastime of royalty and elites; they were considered an aristocratic and gentlemanly pursuit (Daston and Park, 2001). A cabinet was the concrete displays of the power, wealth, and influence of its owner; inside the cabinet, the rare and exotic were presented all together in an effort to dazzle and even overwhelm the viewer (Daston and Park, 2001; Reilly, 2011). Though I was unable to determine for certain whether Christian II had his own cabinet of curiosities, one can imagine that he would have at least been familiar with, and possibly inspired by, other cabinets of curiosities even if he did not, in fact, have one himself.

While cabinets held both natural and artificial wonders, they also commonly contained objects that juxtaposed the natural with the artificial. This fusion was evident in objects like sculptures with hair formed of coral, ceramic vessels made to look like vegetables, and nautilus shells topped with golden figures of animals and people. Automata fit perfectly into this liminal area between natural and artificial (or nature and art) and thus became a staple component of cabinet collections from the 17th century onward (Daston and Park, 2001; Endt-Jones, 2015; MacGregor, 2007). Thus the Spider is a 17th century example of the merging of natural/artificial, nature/art and is a document of this phenomenon.

Sometime after Hedwig died, the Spider passed into the possession of August the Strong (1670-1733). With August the Strong, the Spider continued to be an amusement for noble audiences and it was placed in August's own cabinet of curiosities, the Green Vault. It was noted that August liked to startle visitors to the Vault by secretly winding up the Spider and allowing it to move across the floor, startling and scaring his guests (Endt-Jones, 2015).

In 1723, August the Strong, as the King of Poland and a patron of arts and architecture, founded the Green Vault as a public museum, making the private collection available to the public ("Green Vault," n.d.; "Machine," n.d.). The Green Vault is currently a collection at the Staatliche Kunstammlungen Dresden (SKD), the Dresden State Art Collection, and the Spider is part of the Historic Green Vault (Grünes Gewölbe) collection – the reconstruction of August the Strong's original treasure chamber (cabinet of curiosities), which was one of the richest in all of Europe ("Green Vault," n.d.).

Musealization of the Spider

As it would be typically exhibited at the SKD, the Spider is displayed in an opulent Baroque setting, seated on a gilt stand in front of mirrored walls, and surrounded by magnificent specimens of gold, silver, gemstones, enamel, mother-of-pearl, ivory, and other lavish objects ("Green Vault," n.d.). In this way, its immediate

DOI: 10.35492/docam/4/2/1

physical context and environment is relatively unchanged since the 17th century; many of the objects that were in the original Green Vault with the Spider are still with it today. Even though August the Strong created a "public museum," his intention for exhibiting his collections to (limited numbers of) the public was strictly to demonstrate his absolute wealth and power ("Green Vault," n.d.).

In more recent years, the Spider has been musealized – transformed to become an object-document or source of knowledge in a place where object data is stored (Maranda, 2009). However, the way in which the Spider is musealized in its own museum is as a document of the collection of a cabinet of curiosities – perhaps only a slight shift for the Spider to go from being a wonder in a cabinet of curiosities to being musealized and displayed as an object common to cabinets of curiosities.

But as long as the object exists, the musealization never ends (Maranda, 2009). In the *Robots* exhibit, the Spider and the other automata were presented as steps along a continuum of technology from the earliest forms of machinery like orreries and astronomical tools that paved the way for automated mechanical creations. In this context, the Spider takes on a new life, imbued with different meaning than it might enjoy at its home in the Green Vault. In *Robots*, presented in the setting of the Science Museum, the Spider becomes an example of a critical stage in the development of technology where man has determined how to create the first forms of artificial life.

Frame 2: the Spider – parts of the whole

In Frame 2 of Gorichanaz and Latham's (2016) analytical framework, the document is broken down into individual components and those components are then examined to see how they contribute to the document as a whole. Two types of documental components are identified: *docs and docemes.* Docs are the intrinsic, physical aspects that make up a document, and docemes are parts of documents, resulting from the documentation process, that can be isolated and analyzed. Docs and docemes are not mutually exclusive; as defined, docs are docemes, but the reverse is not true. Docemes are flexible and can be adapted to analytical needs by virtue of their scalability. For example, a doceme within a book-as-document could be a delimited as a single image, chapter, paragraph or even physical aspects of the book [docs] like the thickness of the paper and the typesetting of the words (Gorichanaz and Latham, 2016). There are innumerable docemes within a document and each doceme can be analyzed for its extrinsic, abtrinsic, and adtrinsic information. The current analysis will examine only a few of these docemes: clockwork [intrinsic], fire-gilding [extrinsic], and independent movement [extrinsic].

Clockwork

The Spider's essential physical [intrinsic] doceme as an automaton is its clockwork. The clockwork documents an important stage in the history of technological development. Prior to the advent of clockwork, mechanical devices, such as they were, were powered by hydraulics, pneumatics, and through the use of weights. The development and use of clockwork allowed devices more precise movement of more complicated actions than earlier systems (Vincent, 2015). Clockwork automaton creation was intricate work requiring high technical skill and by the late 14th century the technical craft of clockwork automata construction had gradually become more closely aligned to the work of a jeweler than that of a blacksmith. By the early 17th century, European clockmakers were creating fine, miniature automata in the form of ships, animals, and humans (Bedini, 1964, Daston and Park, 2001). The Spider is a document of this clockwork phase of technological advancement and the widespread creation of exquisite clockwork automata. Technological evolution could also be a system in which to investigate the Spider as a document in Act Two, Frame 3.

Fire-gilding and independent movement

For the purposes of this analysis, the two extrinsic docemes, fire-gilding and independent movement, are examined together. Though they are two different types of docemes – one a manufacturing process and the other a result of the way the intrinsic properties of the Spider behaves – we will see that they both document a similar, historical perception of the Spider and other automata.

As noted earlier, the Spider was a small, free-moving machine, able to move forward through space. These characteristics stand in contrast to many other automata of the time which were mounted on pedestals, cabinets, and other bases. The bases generally served to hide the inner mechanics of the automaton so the viewer only observed the somewhat magical, seemingly unaided movement of the figure. The magical movement reinforced the 13th and 14th century belief that automata were supernatural by virtue of the fact that they occupied the liminal area between natural and artificial, animate and inanimate (Vincent, 2015). Viewers would have been familiar with *real* spiders and the way they scuttle, but the Spider was more similar to its referent than many other automata were to theirs. The Spider could more accurately mimic the actual movement of a spider as opposed to a device that looked and moved similarly to a spider, but differed by being tethered to the base that housed its engineering. That the Spider was not restrained in its movement by the presence of a base, made it and similar automata especially magical and thus, potentially dangerous.

Other aspects of the Spider that made it seemingly magical and potentially sinister, aside from its unnatural natural movement, were the processes used in its creation. The fine metalwork required to make the Spider, namely the fire-gilding

DOI: 10.35492/docam/4/2/1

of the gold-colored brass to the body, was more complicated and generally more misunderstood by the public than the normal blacksmithing work with which most people were familiar. Fire-gilding was a method of applying a thin layer of metal to another metal object that utilized mercury, beeswax, salts, and other chemicals in a complex process. This process resulted in a finished product, like the Spider, that appeared to have magically been transformed into gold ("Gilding," n.d.).

Knowledge of chemistry, especially advanced processes like those involved in fire-gilding, was not widespread among the general population living in 17th century Europe. Berryman (2003) notes that when people do not understand the technology of something, be it gilding or clockwork, efforts to understand it often depend on explanations involving magical, supernatural, or divine powers. As gilding used also used substances considered to be magical or powerful, like mercury, to turn non-gold metals into gold, clockwork automata makers were considered akin to alchemists and sorcerers – especially when they could imbue the constructed golden body with the ability to move on its own (Bedini, 1964; Mauries, 2002). This is evident from Medieval romances which describe the makers of automata magicians and scholars rather than artisans. These abilities were interpreted as being at least in competition with the Creator, if not being fully in opposition to the Creator (Daston and Park, 2001; Hyman, 2011). It was in this light that Thomas Aquinas is said to have destroyed a human automaton that belonged to Albertus Magnus; the movement and abilities of the automaton struck Aquinas as too realistic, thus the devil must have been involved in its creation (Reilly, 2011).

Roger Bacon (c. 1220 - 1292), a Franciscan friar and scholar, attempted to dissociate automata from these notions of demonic influence. Bacon argued that these mechanical creations were not wonders because they were unnatural, and thus possibly demonic, but instead the art of the automaton was wondrous precisely because it was created through natural forces. In his view, nature created the system in which art can be produced and that same system allows art to be aesthetically pleasing and/or elicit emotions. Automata were wonders, argued Bacon, because the natural system that permits their creation is wondrous (Daston and Park, 2001).

Frame 3: the Spider as part of a system

Documents do not exist in a vacuum. Besides existing as a whole (Frame 1) and as the sum of its component parts (Frame 2), the Spider exists as a part of a(n infinite number of) system(s). The Spider will be examined as a document operating within the systems of 17th and 18th century natural philosophy and 18th century social change.

System - natural philosophy

Concepts of natural philosophy have changed over time, but the 17th and 18th centuries saw an era of natural philosophy that largely originated with the observation of automata. René Descartes (1596-1650) was a small child when the Spider was created around 1604. As an adult he visited the gardens of Saint Germain and was profoundly influenced by the (primarily hydraulic) automata sculptures there. This experience inspired Descartes to envision the universe and natural world as a huge clockwork instrument – a type of automaton made by the Creator. In his conception, humans are essentially moving, functioning statues traveling through a machine (the world) which was built by God (Reilly, 2011). This philosophy, known as mechanical philosophy, saw no difference in the mechanical bodies of automata created by artisans and the living human body machines made by God, with a few exceptions: God's creations were of a higher quality, more complicated, and better designed than those of man as exemplified in the fact that man-made automata did not have a language and could not respond to their environment with flexible behaviors (Daston and Park, 2001). Descartes wondered if all of nature itself was just a collection of automata. He observed severed heads of executed criminals which continued to twitch for a period of time after death and interpreted this "movement without will" as like an automaton; the automaton has movement, but no life and no will (Daston and Park, 2001). Others of the time also noted how some species could regrow lost limbs, tails, etc. or even survive in segmented forms and suggested that this could belie a mechanized nature in the biological world (Endt-Jones, 2015).

Later in the 17th century, the field of physiology was dominated by mechanist theories, especially as they concerned bodily functions. A well-known automaton that encapsulated this philosophical movement was the Defecating Duck. This device was a mechanical duck that sat on top of a cabinet. When activated, the duck would bend down to "eat" a piece of food and after a few moments, a small pellet would be delivered from the back of the duck – automaton poop (Hyman, 20011; Riskin, 2003). The purpose of the Duck was as an experiment to see what functions of living creatures could be reproduced with machinery, how accurately they could replicate the function, and what this reproduction might be able to illuminate about how natural bodies actually work (Riskin, 2003).

As automaton creators like Vaucanson (1709-1782), who created the Defecating Duck, continued to make automata, the design of many of these machines changed from being mere *representations* of the natural referent (e.g., duck, spider, human) to an attempted biological *simulation* of the referent. The automata of Vaucanson and Jaquet-Droz (1721-1790), in contrast to those of earlier automata makers, endeavored to not only imitate the natural movement of the natural referent, but to also recreate the physiology of it in mechanics. Jaquet-Droz's Lady-musician, created in 1774) was designed with the help of the village

DOI: 10.35492/docam/4/2/1

surgeon. The mechanics of her hands were modeled on actual, human hands and look surprisingly like biomechanic prosthetics of today. Vaucanson's "moving anatomies" and the automata of Jaquet-Droz were intended for physiological experimentation. They were used to determine how bodily systems functioned and also to test medical therapies (Reilly, 2011; Riskin, 2003). The automata attempted to give insight into how the human (and animal) body works and were used as guides to investigate organic functions (Berryman, 2003; Reilly, 2011). During this time in the late 18th century, automata creators were also experimenting with various materials out of which to create their automata in order to make them ever more realistic in their movement and physiology. Materials like leather, cork, papier-maché and others gave the automaton a more lifelike look and feel as well as making the movement more organic and accurate in its depiction of the natural referent (Riskin, 2003).

The Spider was created before Vaucanson and Jaquet-Droz were alive and as such was not an attempt to replicate a spider's actual physiology, but the Spider and automata like it were pivotal in inspiring the 17th and 18th century natural philosophers to examine how natural bodies operate. Automata popularized the scientific revolution of the 17th and 18th centuries and the eventual emergence of coffeehouses gave science enthusiasts a place to gather and share scientific ideas and concepts (Cook, Jr., 1995).

System – social structure change

Daston and Park (2001) describe an automaton in the collection of Benoît which held a mirror up so that visitors could see themselves as they entered. As they moved into the room and past the mirror, they were made immediately aware of any flaw in their appearance or behavior and could then adjust either or both, as necessary. By literally letting people "look at themselves" as they entered, the mirror-holding automaton thus reinforced social ideas of how to look, act, and be seen in public according to the stringent social standards of the 18th century. In this way, they argue, the purpose of the automata was a "civilizing intent." Automata helped the viewer, be they noble or common, internalize these standards while also giving the viewer a vision of a more affluent life that could be achieved through mastery of the proper ideal and behaviors as exemplified in the regular, predictable movements of the automaton (Daston and Park, 2001).

For a time, automata became a symbol of the liberal v. the mechanic social concepts, sometimes conceived of as private v. public, or more specifically, "benevolent society" v. "private self-interest" (Wetmore, 2009). Aristocracy considered themselves liberal, public members of benevolent society while considering individuals like laborers and farmers to be mechanic (like automata), private, self-interested. They believed that "mechanical" employment degraded

people and prevented them from enlightening themselves or society. Aristocrats saw these people as only working to survive rather than better themselves, their society, or the world and thought them to be more concerned with their own interests and preservation (Wetmore, 2009). Upper classes believed that they were superior to the private/mechanic because, since they didn't have to survive through physical labor (less like automata than the mechanic), they were free to "follow the dispositions of the mind." For this reason they believed they were more capable of feeling sympathy, working for the public good, and enlightening themselves and others (Wetmore, 2009).

A shift in this public/private-liberal/mechanic concept began in 18th century Britain with a newly affluent middle class of commercial society that began to emerge and a form the public sphere. The public sphere allowed private citizens (non-elite) to voice their opinions on matters such as politics, morality, and manners – matters which had previously been the purview of the noble and elite (Daston and Park, 2001). The growing public sphere caused much anxiety in the private sphere (royalty, nobles, elites, etc.) due to its expansion of communication networks like print media, coffeehouses, literary circles, and other areas where the new "public" was able to discuss ideas about science, nature, democracy, equality, and freedom. Unsurprisingly, the private class' anxiety caused them to declare that the ever-increasing influence of the commerce and the public sphere would lead to the proliferation of vice and other moral degradation (Reilly, 2011).

In the earlier 18th century, automata had been celebrated by aristocrats as symbolizing the ideal, even influencing fashion to make women appear like life-sized, mechanized dolls with rosy cheeks and large, powdered wigs. This was perhaps nowhere more perfectly captured than in the historical figure of Marie Antoinette. Not only did Marie Antoinette famously wear the elaborate, doll-like, powdered wigs, but she was even trained by a ballet master in order to learn how to move her body as "a mechanism most ingeniously contrived," an automaton. She even had an automaton created in her image which wore clothing made from her own and a wig fashioned from her own hair (Reilly, 2011).

Intellectual movements spurred by the American and French Revolutions of the late 18th century began pervade the public sphere. Now, automata which were previously seen as ideals of aristocracy and wealth, were associated with the excesses and indulgences of upper classes (Reilly, 2011). It seems appropriate that automata, which had originally been produced in Europe to fill the cabinets of curiosities of the wealthy and powerful in order to display that power, wealth, and influence to the public became a negative symbol of their disproportionately extravagant lifestyles.

Conclusion

DOI: 10.35492/docam/4/2/1

This document analysis has only begun to scratch the surface of the documentality of the Spider. As illustrated in this analysis, documents can be examined at a variety of frames from the physical in its entirety, to the component parts of the document, to the sociocultural systems in which it existed and was used (Gorichanaz and Latham, 2016). In addition to these frames of examination, each frame can be explored for different types of information: intrinsic, extrinsic, adtrinsic, and abtrinsic. There are a limitless number of ways that an object can be investigated as a document and the more that we can use frameworks like those presented by Gorichanaz and Latham (2016), the more information we can discern about an object, making it more useful for exhibits, research, education, etc.

The Spider continues to amass more meaning every day as its history grows longer and longer and more and more people encounter it, having their own experience with it and placing their own meaning and value on it. Over the course of its life it has been used to document a ruler's wealth and power, a technological step in the evolution of artificial life and robotics, and as a constituent element of Christian II and August the Strong's cabinets of curiosities, and it will continue to document innumerably more bits of information and meaning throughout its life.

Figure 1. The Spider automaton from the Green Vault Collection at the Dresden State Art Collections, Germany. Image from http://skd-online-collection.skd.museum/imagescreate/image.php?id=118405&type=gross

References Cited

Bedini, S. A. (1964). The role of automata in the history of technology. *Technology and Culture, Vol. 5*(1), 24-42. http://www.jstor.org/stable/3101120.

Berryman, S. (2003). Ancient automata and mechanical explanation. *Phronesis, Vol 48*(4), 344-369. http://www.jstor.org/stable/4182737.

Classen, C. (2007). Museum manners: The sensory life of the early museum. *Journal of Social History, Vol. 40*(4), 895-914.

Cook, Jr., J. W. (1995). From the age of reason to the age of Barnum: The great automaton chess-player and the emergence of Victorian cultural illusionism. *Winterthur Portfolio, Vol 30*(4), 231-257. http://www.jstor.org/stable/4618515

Daston, L., & Park, K. (2001). *Wonders and the Order of Nature, 1150-1750.* New York: Zone Books.

Endt-Jones, M. (2015). Living jewels, creepy crawlers and robobugs: Insects in the Wunderkammer, surrealism and contemporary art. In Wamberg, J. & Paldam, C. S. (eds.), *Art, technology and nature: Renaissance to postmodernity* (67-80). Burlington, VT: Ashgate.

Gilding. (n.d.). Retrieved April 15, 2017 from Wikipedia: https://en.wikipedia.org/wiki/Gilding

Gorichanaz, T., & Latham, K. F. (2016). Document phenomenology: A framework for holistic analysis. *Journal of Documentation, Vol 72*(6).

Green Vault, Dresden State Art Museums (n.d.). In *Google Arts & Culture.* Retrieved from https://www.google.com/culturalinstitute/beta/u/0/partner/grunes-gewolbe-green-vault

Hyman, W. B. (2011). *The Automaton in English Renaissance Literature.* Burlington, VT: Ashgate.

MacGregor, A. (2007). *Curiosity and enlightenment: Collectors and collections from the sixteenth to the nineteenth century.* New Haven, Connecticut: Yale University.

Machine in the form of a spider (n.d.) in *Staatliche Kunstsammlungen Dresden Online Collection.* Retrieved from http://skd-online-collection.skd.museum/en/contents/showSearch?id=118405#longDescription

Maranda, L. (2009). Museology: back to the basics musealization. *Museology: Back to Basics*, 251.

Mauries, P. (2002). *Cabinets of curiosities*. New York: Thames & Hudson.

Reilly, K. (2011). *Automata and mimesis on the stage of theatre history.* New York: Palgrave Macmillan.

Riskin, J. (2003). The defecating duck, or, the ambiguous origins of artificial life. *Critical Inquiry, Vol. 29*(4), 599-633. http://www.jstor.org/stable/10.1086/377722.

Vincent, C., Leopold, J. H., & Sullivan, E. (2015). *European clocks and watches in the Metropolitan Museum of Art.* New York: Metropolitan Museum of Art. Retrieved from https://books.google.com/books?id=Dd_WCgAAQBAJ

Wetmore, A. (2009). Sympathy machines: Men of feeling and the automaton. *Eighteenth-Century Studies, Vol. 43*(1), 37-54. http://www.jstor.org/stable/25642159