ILLUSTRATIONS AND (L)IMITATIONS IN WESTERN ART AND SCIENCE: A CRITICAL BIOGRAPHY OF INTERSECTIONS IN THE CO-CREATION OF LIBERAL HUMANISM

Ilustraciones e (l)imitaciones en el arte y la ciencia occidentales: Una biografía crítica de las intersecciones en la co-creación del humanismo liberal

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ABSTRACT

This paper offers a critical biography revealing certain historical intersections and divisions between Western art and science and points to specific moments where they have worked together through an exclusionary version of liberal humanism. This version of liberal humanism was often constructed through the dehumanization of women, people of color, people with disabilities and sexual minorities who were relegated to the non-human, the almost human, the animal or the monstrous. As part of the methods, it offers a critical genealogy, sifting through the cultural vestiges of art, science, philosophy, medicine, atlases, illustrations, colonial and eugenic discourses, feminist, queer, and postcolonial theories, and visual culture in order to recover and reconstruct specific connections between art and science in different historical periods (from the late 1400so the present). By drawing attention to the fact that "the human" has been a shifting and unstable signifier, this paper concludes that both Western art and science have the ability to help co-construct humanity by formulating new more equitable assemblages or the power to magnify already existing power disparities.

Key Words: History of art and science, liberal humanism, critical theory, feminist science studies, post-humanism.

RESUMEN

Este artículo ofrece una biografía crítica que revela ciertas intersecciones y divisiones históricas entre el arte y la ciencia occidentales y señala momentos específicos en los que han trabajado juntos a través de una versión excluyente del humanismo liberal. Esta versión del humanismo liberal a menudo se construyó a través de la deshumanización de las mujeres, las personas de color, las personas con discapacidades y las minorías sexuales que fueron relegadas a lo no humano, lo casi humano, lo animal o lo monstruoso. Como parte de los métodos, ofrece una genealogía crítica, tamizando los vestigios culturales del arte, la ciencia, la filosofía, la medicina, los atlas, las ilustraciones, los discursos coloniales y eugenésicos, las teorías feministas, queer y poscoloniales, y la cultura visual para recuperar y reconstruir conexiones específicas entre el arte y la ciencia en diferentes períodos históricos (desde finales del siglo XV hasta el presente). Al llamar la atención sobre el hecho de que "lo humano" ha sido un significante cambiante e inestable, este artículo concluye que tanto las artes como las ciencias occidentales tienen la capacidad de ayudar a co-construir la humanidad mediante la formulación de nuevos ensamblajes más equitativos o el poder de magnificar las ya existentes disparidades de poder.

Palabras clave: Historia del arte y la ciencia, humanismo liberal, teoría crítica, estudios científicos feministas, posthumanismo.

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1. Arriving at a Genealogy

The purpose of history, guided by genealogy, is not to discover the roots of our identity but to lead to its dissipation […] It seeks to make visible all those discontinuities that cross us (Foucault, 1977, p. 162).

It matters how we arrive at the places we do (Ahmed, 2007, p. 2).

I would like to insist on the embodied nature all vision and so reclaim the sensory system that has been used to signify a leap out of the marked body and into a conquering gaze from nowhere. This is the gaze that mythically inscribes all the marked bodies, that makes the unmarked category claim the power to see and not be seen to represent while escaping representation (Haraway, 1988, p. 158).

This paper sifts through certain cultural vestiges of art, science, philosophy, medicine, atlases, illustrations, colonial and eugenic discourses, feminist, queer, and postcolonial theories, and visual culture in order to reveal specific connections between art and science in different historical periods. This critical feminist excavation moves between different periods (from the late 1400s to the present) in order to explore instances where specific trends and intersections of Western art and science have worked together to prove the existence of physical and biological differences in regards to race, gender, sexuality, and ability in Western culture in which these differences have negatively impacted those with less power in society. Likewise, the critical biography offered uncovers historical moments where those who hold the power to make "objective truth claims" have often been those who have constructed, recorded, and presented as "fact" the histories of these events which has, in turn, worked to elevate and maintain the power of some while restricting the power and movement of others. As feminist and phenomenological theorist Ahmed asserts, "What is reachable is determined precisely by orientations that we have already taken" (2007, p. 55). She continues,

> For bodies to arrive in spaces where they are not at home, where they are not in place involves hard work; indeed, it involves painstaking labor for bodies to inhabit spaces that do not extend their shape. Having arrived, such bodies might in turn acquire new shapes. And spaces in turn acquire new bodies (2007, p. 62).

Accordingly, without the labor of other critical theorists, scientists, and artists, this paper would not be able to turn towards the subjects of art, science, and social justice here. Hence, this genealogy pays

homage to all who have struggled against societal and academic norms to provide the opportunity to disrupt mistakes of the past. As Foucault (1977) contends:

> Genealogy does not pretend to go back in time to restore an unbroken continuity that operates behind the dispersion of forgotten things… Genealogy does not resemble the evolution of a species and does not map the destiny of a people, it is to identify the accidents, the minute deviations—or conversely, the complete reversals—the errors, the false appraisals, and the faulty calculations that gave birth to those things that continue to exist and have value to us (p.146).

Unlike traditional historians who attempt to fight against their positionality in order to stay "objective" in their research, genealogy compels us to stress the inconsistencies, subjectivities, and complex play of events involved in any historical, scientific, artistic, philosophical knowledge claim. Indeed, this genealogy has its critical feminist, decolonial "object" in mind and, thus, stresses the partiality of its assemblage or "situated knowledge":

> The moral is simple: only partial perspective promises objective vision. All Western cultural narratives about objectivity are allegories or the ideologies governing the relations of what we call mind and body, distance and responsibility. Feminist objectivity is about limited location and situated knowledge, not about transcendence and splitting of subject and object. It allows us to become answerable for what we learn how to see (Haraway, 1988, p. 583).

Thus, this paper engages with multiple histories to "dig up" different predetermined "objects" involved in Western art, science, and feminism. For instance, by investigating science, which is associated with objectivity, masculinity, and the mind, and revealing its inherently partial, sometimes even, oppositional, historical connections with art, associated with subjectivity, femininity and the body, the discontinuity and falsehood of both claims becomes evident. Yet, oftentimes, Western art and science have had contradicting roles in political projects in different historical moments, where science typically has more institutional privilege and art is typically more critical of these institutions. Yet these hierarchical separations have not existed trans-historically; rather, they involve a complex interplay of events that have affected how many Western people view these mutable, dynamic, complex and cross-disciplinary fields today. As such, by subverting claims about certain realities and producing other forms of knowledge, humanity can arrive at new places where science, art, history, and bodies are constructed differently. As Foucault (1977) writes,

> History becomes 'effective' to the degree that it introduces discontinuity into our very being—as it divides our emotions, dramatizes our instincts, multiplies our body and sets it against itself […]. That is because knowledge is not made for understanding; it is made for cutting (p. 154).

According to Foucault (1977), rather than asserting the existence of an objective and linear history waiting to be revealed, genealogy strives to record its own history (p. 152). He argues that genealogy should stress the pluralities and contradictions involved in all truth constructions. Since there is a multitude of interpretations around different events, objects, people, etc., history can never be completely known; all that can be really be understood is the knowledge produced in deep-rooted disciplinary practices. Ahmed (2007) concurs, the disciplinary lines of academia (such as the lines between art, science, and philosophy) are drawn to keep the inheritance (and interpretations) of knowledge intact:

> Disciplines also have lines in the sense that they have a specific "take" on the world, a way of ordering time and space through the very decisions about what counts as within the discipline. Such lines mark out the edges of disciplinary homes, which also mark out those who are "out-of-line" […] The promise of interdisciplinary scholarship is that the failure to return texts to their histories will do something… The following keeps taking us in a different direction, as we keep noticing other points (pp. 22-3).

Like Ahmed, many other marginalized people have never had a disciplinary residence to call home and, therefore, do not feel secure within their borders. However, women's studies and other interdisciplinary residences provide a broad array of knowledge to explore functioning simultaneously as an interdisciplinary and intra-disciplinary. Hence, following in the deviating lines of Ahmed and other interdisciplinary feminist, queer and critical scholars, these disciplines draw researchers to the danger of non-linear knowledge. Foucault, likewise, stresses the importance of danger in academic research, writing:

> The will to knowledge does not achieve a universal truth; man is not given an exact and serene mastery of nature. On the contrary, it ceaselessly multiples risks, creates dangers in every area […] it releases those elements of itself that are devoted to its subversion and destruction" (1997, p. 163).

Many people typically marginalized within the sciences have tended to follow lines that may have led them away from the sciences (women, for instance, are often made to feel out of place in sciences and this alienation can cause women to choose other directions). Nevertheless, recently, many scholars have moved towards the sciences and realized that one does not have compartmentalize or look in different

directions to explore art and science but can turn toward the "co-incidences" of the two (Ahmed, 2007, p. 39). Ahmed expounds,

> The dash in co-incidence must be highlighted here to avoid turning the shared arrival into a matter or chance. To 'co-incide' suggests how different things happen at the same moment, a happening that brings things near to other things, whereby nearness shapes the shape of each thing (2007, p. 39).

Hence, the co-incidences between art and science in different historical periods provide provocative information about the shape these two disciplines take and have they have likewise shaped the Western world and the global understanding of it.

2. The Role of Visual Imagery

Visual culture assembles diverse accesses to a phenomenological world that sustains and envelops us primarily through our senses, especially through our optical sense, which extends the reach of our sensory body (Wilding, 2003, p. 30).

By examining the role of visual culture in certain illuminating moments in the history of both Western art and science, the interdependence of both becomes clear. In past decades, researchers have revealed that the arts and sciences have not always been considered opposing or antagonistic endeavors and that, indeed, the sciences do rely on the humanities, and the humanities do, unquestionably, rely on the sciences. For instance, Martin Kemp's book *Visualizations; The Nature Book of Art and Science* (2004) explores "the shared motifs in the imaginative worlds of artist and scientists […] [in] Western art from the Renaissance to the present day" (p. v). Visual imagery affects many aspects of culture, including almost every discipline in Western academia. Despite the allegations of the disparities between the arts and sciences, the visual representations in science have affected the production of art at the same time that artistic conventions have affected the production of science. As feminist art historian Jones (2003) writes, "Visual culture is a rubric and a model of critical thinking about the world of images saturating contemporary life" (p. 1)**.** Similarly, without the collaborative work of scientists and artists, neither discipline would exist as it does and many artists have worked as scientists and vice versa. After all, the

Renaissance is a foundational source for contemporary art and science and excelling at both science and art is part of the definition of a "Renaissance man" (a man who, in the likeness of some Renaissance elites, excels in many areas of knowledge, including the arts and sciences).

Likewise, Pamela Smith (2002) asserts "Renaissance and post-Renaissance Western Europe played a unique role in the development of various arts and sciences devoted to the imitation of nature" (p. 3). Perhaps in more recent times, western science has this "[devotion] to the imitation of nature" even further to include its control, creation, and manipulation. For instance, Haraway (1997) points to another connection between the Renaissance and current scientific and artistic practices:

> The conjoined Western modern sense of the "real" and the "natural" was achieved by a set of fundamental innovations in visual technology beginning with the Renaissance. Twentieth-century scientists call on this earlier visual technology for insisting on a specific kind of reality, which makes today's observers forget the conditions, apparatuses, and histories of its production. Especially in computer and information sciences and in biotechnology and biomedicine, representations of late-twentieth century technoscience make liberal use of early modern European art/humanism/technology (p. 182).

Haraway uses two advertisements by Wally Neibart in the magazine *Science* (1995) to demonstrate how contemporary scientific culture is influenced and connected to Renaissance ideals. In these advertisements, Neibart cleverly comments on the fetishization of the genes by referencing biotechnologies "hyperhumanist discourse" and linking biotechnologies with consumer culture and Renaissance art (Haraway, 1997, p. 151). In the first advertisement, he drew a framed DNA sequence hung on a gallery wall with other Renaissance portrait paintings, while one prosperous-looking (white) man tells another prosperous-looking (white) man that he acquired the work via the autoradiograph machine that Neibart is advertising: "like humanist paintings, the autoradiograph is a self-portrait of man in its particular form […] the DNA gel is about technology, instrumentation, optics, framing, angle of vision, lighting, color, new forms of authorship, and new forms of patronage" (p. 153-4). In the second advertisement, which is for "DNA labeling and detection products", Neibart draws multiple copies of Leonardo da Vinci's painting *Mona Lisa* along with the headline: "Smile, Renaissance™ non-rad DNA labeling kits give you reproducible results, not high backgrounds" (p. 157). By referencing Andy Warhol's silkscreen *Thirty*

Things Are Better Than One, Neibart's drawing ironically comments upon reproduction, authenticity, and "high" and "low" culture and their relationship to current biotechnologies (p. 158). Though the juxtaposition of these themes, Neibart has turned the cloned Mona Lisa's into reproducible commodities just like many genetic practices have done to DNA (p. 156). Moreover, "Leonardo […] has been appropriated for stories of origin, vision and its tools, scientific humanism, technical progress and universal extension", revealing the "technoscientific preoccupation with Leonardo and his brethren in the "degraded" contexts of business self-representation, advertising inside the scientific community, science news illustrations […] magazine cover art and comic humor" (p. 156).

Hence, despite the commonly held split between artistic and scientific culture, in much of Western history these seemingly independent endeavors have been figured as consistent or complimentary intellectual undertakings in certain incarnations. In the research by art historian Samuel Edgerton (1985), he stresses visual arts influence on scientific practices by highlighting the effects that artistic scientific illustrations have had on many prominent "modern" scientists. Edgerton writes,

> It may have been of no small significance to their later contributions that the first generations of 'modern' scientists like Francis Bacon, Galileo, William Harvey and Descartes were also the first to have before them as schoolboys scientific textbooks illustrated in the new renaissance chiaroscuro [strong contrast between light and dark to cause the figure to stand out in the composition] and linear perspective (1985, p. 169).

Likewise, in their book *Objectivity*, historians and critical theorists Daston & Galison (2007) discuss the formidable influence of atlas illustrations on scientists in different epistemic trends and historical periods. They profess, "Not only do images make the atlas; atlas images make science […] Atlas maker's woo, badger, and monopolize the finest artists available" (p. 23). They continue, "These images affect scientists and how they learn how to see […] Atlases are intrinsically collective […] Almost all [atlases] depend on a close working relationship between scientist and illustrator" (p. 26). While all of the connections traced here between art and science highlight the importance of the visual focus for "proving" certain physical and biological differences, it is almost too impossible to delineate art and science throughout Western humanist ideology.

3. Epistemic Trends: Creative Concords and Radical Ruptures

Daston & Galison (2007) examine how different epistemologies affect how art and science inform each other and how these have shifted dramatically throughout Western history. They expound upon several different belief systems from the eighteenth to twentieth-century including "truth-to-nature", "objectivity", and "trained judgment" which have affected how images are used, understood, and valued in science. Nevertheless, while these "epistemic virtues" are characteristic of certain periods in Western science, the boundaries between them cannot be clearly defined:

> the emergence of objectivity as a new epistemic virtue in the mid-nineteenth century did not abolish truth-to-nature, any more than trained judgment in the early twentieth century eliminated objectivity […] each successive stage presupposes and builds upon, as well as reacts to, the earlier ones (p. 18).

Likewise, the knowledge production practices before these trends directly affected their development, and each system has affected how both are conceptualized today. "What passes through history is not only the work done by generations, but the 'sedimentation' of that work is the condition of arrival for future generations" (Ahmed, 2007, p. 40).

Before discussing the principles of "truth-to-nature", the historian of art and science Pamela Smith (2002) creates links between the material conditions of art, naturalism, and commerce in late–fifteenth to sixteenth-century Europe. She states:

> That a scientist would supplement his verbal description of the wonders he encountered, is one obvious link between art, science, and commerce, but a more profound connection between these three areas can be found in their intersection in the body in sensory observation and sensual consumption, in the use of the senses to know nature, and in the sensory enjoyment of the things of nature and art (p. 18).

During this time, there was only a limited separation between art and science in Europe. While artisans and naturalists had different roles in society, they were both valued for producing visual knowledge about nature and the world. As Smith (2002) asserts, "The formation of a new visual language would eventually become an auxiliary tool of proof in the natural science" (p. 9). Artists, like naturalists, were tasked with the role of recording, revealing and re-presenting the wonders of the world, such as "exotic"

plants, lands, animals, insects, and people, to anxious consumers. Furthermore, Smith (2002) relays the interconnections and interchangeability of art objects and nature, writing, "art and nature came to be closely associated or even interchangeable between the 1490s and 1540s" (p. 65). This similitude allowed artists considerable freedom; if one could adeptly craft one's representations to appear "real", the (re)-presentation, in effect, became real: "The meditation on the boundary between nature and art sometimes produced witty counterfeit images, such as Joris Hoefnagel's imaginary insects that played with the viewer's presumptions about verisimilitude" (Smith, 2002, p. 11). For instance, in his painting, *Dragonfly, Pear, Carnation and Insect* (1591), Joris Hoefnagel drew an imagined insect next to an actual depiction of a dragonfly. Considering the relationship between art and naturalism in Europe and the creations made by scientists/artists today, science is «no longer simply the story of what is "really" there» (Smith, 2002, p. 11).

Even though most of the scientists/artists working within these epistemic shifts were men (since women were usually excluded), some women also forced open the doors and forged connections between art and naturalism. For example, Maria Sibylla Merian traveled from her home in the Netherlands to draw and study the lives of the insects in Surinam in 1699. For a women painter and naturalist to self-finance a voyage to Surinam during this time with only her 21-year-old daughter as her assistant "to document the metamorphosis of exotic butterfly and moths […] represents one of the most heroic acts in the history of the natural sciences" (Kemp, 2004, p. 46). In *Metamorphosis of the Insects of Surinam* (1705), a painting from this journey, she records the life cycle of the moth, *Arsenure armida,* as well as the plant that sustains it (Kemp, 2004, p. 47). Kemp (2004) proclaims,

> She is responsible for the forging of a new vision of how life cycles in insects could be brought before our eyes […]The eggs, larvae, chrysalises, and mature insects are portrayed in living communion with the plant on which their 'worms' feed—sometimes showing more than one species per plate where she had observed that a plant was not the exclusive domain of one kind of insect (pp. 46-7).

Thus, in her "visual journey through the wonders of transformation", unlike many of her male counterparts who focused on hierarchy and domination, Merian, who highlighted the beauty and

cooperation involved in nature and criticizing the Dutch treatment the slaves on the colony, uses it as a model for human behavior (Kemp, 2004, p. 47). Likewise, it comes as no surprise that she also stressed the strength of the female sex in her art and observations: "Each year this kind of caterpillar comes three times to this tree […] The lower and smaller one is the male; the larger and the upper one is the female" (Kemp, 2004, p. 47).

Like in sixteenth-century Europe, in the epistemic value of "truth-to-nature" (which took place in the eighteenth and nineteenth centuries), art and science are also inextricably linked as artists and scientists worked together to create idealistic representations of nature. Working closely with the artists, scientists would correct the "imperfections" and "blemishes" on the illustrations "to ensure the fidelity of their images" (Daston & Galison, 2007, p. 42). They expand, "To this end, they carefully selected their models, watched their artists like hawks, and smoothed anomalies and variations in order to produce what we shall call 'reasoned images'" (p. 42). However, with the popularization of photography in the sciences in the mid-nineteenth century, scientists reacted strongly against the perceived "subjectivity" of the truth-to-nature and claimed that human intervention and idealization would "taint" the reliability of scientific theories and allow expectations to affect results (Daston & Galison, 2007, p. 34). Despite the recognition of the connections between art and science during the Renaissance, during the Enlightenment, artists and scientists started to understand their work as oppositional ventures: "Artists were exhorted to express, even flaunt, their subjectivity, at the same time that scientists were admonished to restrain theirs" (Daston & Galison, 2007, p. 37). Instead, objectivity became the new epistemic ideal in science, and scientists worked hard to eliminate all traces of human involvement from their work at the same time that artists were required to communicate their individuality through theirs (p. 37). As Daston & Galison (2007) state, "To be objective is to aspire to knowledge that bears no trace of the knower—knowledge unmarked by prejudice or skill, fantasy or judgment, wishing or striving" (p. 17). Yet this ideal also came with a price as "incidental oddities cluttered images; the objects depicted might not be typical of the class they were supposed to represent" (Daston & Galison, 2007, p. 43). Another consequence was the banality of the research it produced. As Kemp (2004) explains of the images in Henry Gray's and T Pick's textbook *Anatomy*,

Descriptive and Surgical (1893)*:* "displaying elegant figure […] in gracious settings became the favoured presentation in the erudite humanist picture books of anatomy, from Andreas Vesalius and Charles Estienne in the Renaissance to Bernard Seigfried in the Enlightenment", after that "the plain, technical textbook, establishe[d] itself as the anatomical bible for generations of students" (p. 70). He argues that the style of bland depiction was "epitomized by Henry Gray's *Anatomy, Descriptive and Surgical*" which "bids to be the most remorselessly unexciting book ever written on an engaging subject" (pp. 70-71). Furthermore, some mathematicians, physicists, and logicians, took objectivity even further too claim all images were "subjective" and purged them from their work entirely (Kemp, 1992, p. 45). As Kemp (2004) elucidates, "This reluctance to use visual images to demonstrate claims about the world came out of the Aristotelian view that art and nature were opposed to one another" (p. 63). Yet strident "objectivity" also lost its prominence in the early-twentieth century as scientists began to realize that strict objectivity was inefficient and instead proposed the epistemology of "trained judgment" where scientists would enhance their images to emphasize a point (Daston & Galison, 2007, p. 46). However, the effects of objectivity still lingered on for much longer. As Kemp reveals, the "the 'non-style'—a technical mode of illustration in which dry imparting of information is the sole conscious focus" was quite influential in the sciences, and "by 1850, there was no branch of institutionalized science that remained untouched and much of twentieth-century illustration was its direct heir" (Kemp, 2004, p. 70).

Ironically, despite these historical precedents, in the twentieth-century another shift took place and the bifurcation between the arts and scientists reemerged. In the advent of the Cold War in the United States, many people stopped looking at social and material relations of scientific knowledge and put blind faith in science, technology and capitalism, which they hoped would "save" them from the Soviets and other "evil" powers (Kemp, 1992, p. 16). Moreover, as scientific pursuits continued to gain prominence in academia, scholars dedicated to studying the social conditions of science began to emerge and question the "objectivity" of science and the white masculine norms it reinforced. Many of these scholars focused on the social construction of scientific knowledge, which put scientists on the defensive. This tension led up to the "Science Wars" (a period of academic hostility –even disdain– around the mid-1980s to the early-

2000s), which was one of the most divisive events to happen between the sciences and the humanities in Western history. Feminist theorist Sharon Begley (2001) reveals one of the "most notorious counterpunch[es]" by scientists during the Science Wars in 1996 (p. 115). She writes,

> Physicist Alan Sokal of New York University wrote a spoof of the "constructivist" argument, passed it off as the real thing and duped the post-modern journal Social Text into publishing it. The editors' gullibility, Sokal argued, revealed the bankruptcy of the constructivists' ideas (p. 115).

After this deceit, many constructivist scholars became more involved with the sciences and scientists became more open to the role of culture in their research, but the bifurcation that occurred because of this event is still far from being reconciled. Furthermore, Daston & Galison (2007) question what these epistemologies signify in this second millennium when computer-generation and nanomanipulation, controlling and creating matter and virtual images at a molecular level, are dominating scientific image making (p. 383):

> Representation is always an exercise in portraiture, albeit not necessarily one in mimesis. The prefix re- is essential; images that strive for representation present again what already is. Representative images may purify, perfect and smooth to get at being, at "what" is. But they may not create out of whole cloth, crossing over from nature to art (p. 382).

One example of the creation sans mimesis, imitation or representation of something that already exists is the work of William Latham, a former fellow at the IBM Scientific Centre at Winchester. Using the design tool *Mutator*, Latham creates computer-generated and animated life forms "endowed with genetic properties which shape their growth" (Kemp, 2004, p. 163). In his program, he allows these sculptural-like creatures grow and interact within a set of boundaries in the likeness of the "processes of natural selection" (Kemp, 2004, p. 163). The work of Latham provides one example of how contemporary creations in art and science are taking the connections between science and art to a new level, perhaps one that neither scientists nor artists are prepared. As Kemp (2004) explains,

> Fractal processes of repeated division […] may be seen as 'art'—just as Renaissance drawings of the Platonic solids […] can be accorded aesthetic status—but they only inhabit a limited domain in the wide domains already colonized by the visual arts (p. 162).

Undeniably, despite the shifts in the consciousness about the role of images in the sciences, visual representations have been one of the main ways that modern scientists learn about previous scientific

knowledge, and this has affected how these scientists practice science and artists practice art. Jones (2003) reveals, "Visual culture […] has been aimed at breaking down disciplinary limitations defining what and how visual imagery is to be analyzed within a critical visual practice" (p. 1). Whether or not scientists value their connections with art or artists realize their connections with the sciences, the formative relationship between them exists: "Nature, knowledge, and knower intersect in these images, the visible traces of a world made intelligible" (Daston & Galison, 2007, p. 53). All these epistemologies still circulate currently —whether it is the connection between truth-to-nature's illustration of an unblemished flower, contemporary genetics' creation of an unblemished apple or objectivity's assertion that science can detach itself from culture. By analyzing the connections between visual culture and other fields, these disciplinary lines can be broken down to produce more interdisciplinary knowledge. Furthermore, there are many real world implications of different relationships between the visual and the scientific in different epistemic trends: the drawing of a live vivisection by Vesalius (1543) serving as a representation of objectivity, Leonardo da Vinci's drawing *The Vitruvian Man* (1487) representing "truth to nature", Carl Linnaeus' publication *Philosophica Botanica* (1797) revealing "trained judgment", and 1899 Louis-Ernest Barrias's sculpture *Nature Unveiling Herself Before Science* (1899) demonstrating the passive display of the female body for the visual pleasures of science. Likewise, Jeff Hutchen's photograph of the Vhevenda tribe virgins in South Africa (2004) can be said to represent trained judgment, even though it also connects to the illustrations of Sara Baartman body as scientific proof of the inferiority of Africans (early 1800s) or Dickinson's illustrations of the genitals of homosexuals (1948) which would all fall under the epistemology of objectivity. Throughout the next sections, this paper discusses how these examples and more worked to construct the liberal human ideal at the exclusion of others.

4. Co-Construction of an exclusionary Liberal Humanism

Even when it is more readily acknowledged that art and science shape each other and transform what questions are asked and projects are created, the liberal humanist ideology behind particular projects

and visions is not deconstructed enough; on the contrary, it is often reified through this research. For example, Kemp (2004) discusses the connections between art and science but rarely offers any critical commentary on the consequences of this relationship. While Kemp's assertion that "The artist and scientist both live within and play active roles in constructing human mental and physical landscapes" proves true, his non-critical discussion of how "wonderful" the institutions are that have developed via the sciences merits evaluation (Kemp, 2004, p. 7). He writes, "What is surprising and wonderful is how these institutions have manifested themselves in the works of innovative scientists in culturally apposite ways" (p. 7). Considering much of the unfortunate history of Western science towards women, minorities, and non-human nature, his un-selective enthusiasm is questionable. For instance, Kemp writes about Vesalius, a French anatomist and illustrator in the 1800s, who drew the board and tools he used for dissections to prove the "veracity" of his illustrations (1543), yet only briefly mentions that Vesalius also drew this board with "an unfortunate pig tethered to its rings and apertures" while "performing the vivisection" (p. 23). Whereas Kemp titled his two-page discussion of Vesalius' work "Vesalius' Veracity", the section could be called "Vesalius' Vivisection" (p. 22). In addition, while the work of queer theorists Foucault and Ahmed situate this paper, Kemp situates his book with a quote by Francis Bacon on the "essential apparatus of a learned gentlemen" ─and the "learned gentleman" (p. 1): hence, male, heterosexual, able-bodied, middle-upper class and European─ i.e. the quintessential Liberal Human Subject in opposition to inferior "other". Like most ideologies, although liberal humanism refers to certain concepts and principles, it is not a unified belief system and has taken different meanings in various historical eras. One could argue that its ideals originate with Aristotle; however, liberal human ideology most notably developed during the late Renaissance and the Scientific Revolution (1600-1700s). As Haraway (1997) writes, "The Italian Renaissance and modernist paintings are signs of the culture of Western Humanism, which in kinship with the Scientific Revolution […] not to mention its class location in the rising bourgeoisie, whose fate was tied to science and technology" (p. 155). Accordingly, the philosophies of Francis Bacon are considered to represent many of the values of liberal humanism including faith in rationality, progress, objectivity, and the control and mastery of nature. Bacon is known as one of the principal philosophers of the Scientific

Revolution (a period of scientific revitalization after the middle-ages), yet during the Scientific Revolution (through the influence of philosophers like Bacon), control, dominance, and masculinity were imposed as scientific ideals. As Lederman & Bartsch (2001) write, "Bacon's language to describe Man's domination over nature uses 'bold sexual imagery'; his words reinforce the female not only as an object, but as an object for exploitation" (p. 65). For example, relating the investigation of the secrets of nature to the investigation of witches during the Inquisition, Bacon declares,

> a useful light may be gained, not for a true judgment of the offenses of persons charged with such practices, but likewise for further disclosing the secrets of nature. Neither ought a man to make scruple of entering and penetrating into these holes and corners, when the inquisition of truth is his whole object (as cited in Merchant, 2001, p. 69).

The Baconian emphasis on control and power over nature was often expressed through sexual (and racial) imagery, including the use of loaded words such as "rape", "slave", and "bound into service", and thus, his philosophies played a pivotal role in scientific experimentation thereafter. For instance, Robert Boyle, a theologian and scientist who was influenced by Bacon, created a vacuum through the use of an air pump, while gleefully watching birds fall from flight as he sucked the oxygen out of the room to demonstrate his discovery. In addition, he also referred to nature as both an object and a woman, stressing that "the empire of man" has mastery "over the inferior creatures of God", which included humans that he viewed as "closer to nature," such women and people of color (Boyle as cited in Keller, 2001, p. 104)

Another prominent figure in the Scientific Revolution was the French philosopher Rene Descartes, who gained prominence just a little after Bacon. Descartes strove "to create a unified system of knowledge base in pure reason […] For him, it was an epistemological problem to relate the thinking self (*res cogitans*) with the external world (*res extensa*)" (Lederman & Bartsch, 2001, p. 65). He believed that the mind and body were separate entities and the mind was superior; in fact, the mind was all that 'mattered' for Descartes. Hence, he believed one should use deductive reasoning to test hypotheses about nature and the external world in scientific experimentation. As Kemp writes,

> Given the prominence of empirical analysis in so many sciences during the 'Scientific Revolution,' it is not surprising that some artists were able to play an active role in the dialogue between various

> types of seeing and knowing, not only in the obvious areas of illustration but also in the more searching evocation of the causes behind natural effects (2004, p. 6)

Likewise, Descartes used vivid illustrations with detailed characters and landscapes (i.e. "his analysis of binocular vision and the inverted image on the retina of a blind man with a pair of sticks") to express his theories in visual terms (Kemp, 2004, p. 39). While Descartes understood that images added another dimension to his theories, he also stressed "illustration by mechanical device was a limited device" and "scolded those who viewed his vivid aids to visualization in too obvious a way" (Kemp, 2004, p. 39).

Despite the claims by humanist and Enlightenment thinkers, nature is not just passively waiting for science to discover and "unveil" her, and the Cartesian dualisms of nature/culture, man/woman, mind/matter, etc. are cultural constructions designed to keep those that benefit from the dualisms in power. As Smith (2002) avers, "They themselves had to gain social authority in order to formulate a picture of the real" (p. 14). Similarly, the idealization of the "liberal human subject", has worked to police the boundaries of "the human" by normalizing the European male body and justifying different forms of oppression against those that do not inhabit this body.[1] For instance, Leonardo da Vinci's *Vitruvian Man* (1487) exemplifies this liberal humanist ideology. To this day, in Western culture, the *Vitruvian Man* is considered to be the "universal" man, yet it is not by chance that the "the perfect man" happens to be a close fit to liberal humanist scientists and artists that purported it, which creates an unobtainable norm for most. Hence, the following sections examine the damage caused by liberal humanist ideology to people in different identity categories including gender, race, sexuality, and ability.

5. Women, Science, and The Male Gaze

In certain paradigmatic intersections between Western art and science gender is repeatedly inscribed through visual means by both disciplines. As Jones (2003) writes, "Feminism has long

[1] This is similar to what Audre Lorde (2005) refers to a "the mythical norm." She writes, "In America, this norm is usually defined as white, male, young, heterosexual, Christian, and financially secure. It is with this mythical norm that the trappings of power reside within this society" (p .339).

acknowledged that visuality (the conditions of how we see and make meaning of what we see) is one of the key modes by which gender is culturally inscribed in Western culture" (p. 1). For instance, in the language of Bacon and Boyle, nature is commonly gendered as female, while culture is associated with masculinity. As ecofeminist theorist Ortner states in "Is Female to Male as Nature Is to Culture?" (2000), "since it is always culture's project to subsume and transcend nature, if women were considered part of nature, then culture would find it 'natural' to subordinate, not to say oppress, them" (p. 245). Likewise, since women have been relegated to the status of "nature", they have also been denied access to the scientific institutions that oppress them because of their perceived "fragility" and "subjectivity": in sum, as nature, they are said to not have the mind for science. While some women did break these barriers (i.e. Marie Curie in the early-1900s and Lise Meitner in the mid-1900s) paving the way for women in the sciences today, many remnants of the masculinist liberal humanist ideals still exist account for the vast under-representation of women in the sciences.

Yet even when women like Maria Sibylla Merian did break these barriers, the knowledge they discovered was often devalued or destroyed. For instance, the Schiebinger (2004a) notes that on Merian's voyage to Surinam, she discovered a plant known as the peacock flower that was used as an abortifacient by the slave women of Surinam (p. 5). Moreover, she stressed that the plant was used for the women's "physical and spiritual survival", writing that "the Indians, who are not treated well by their Dutch masters, use the seeds […] to 'abort' their children, so that their children will not become slaves like they are" (in Schiebinger, 2004a, p. 3). Furthermore, in her notes, she gives the slave women agency by humanizing them (which most Dutch travelers and colonizers worked to dehumanize) noting that slaves told her themselves that they "sometimes take their own lives because they are treated so badly" (p. 3). Yet the knowledge of this plant and its uses for terminating pregnancy or the violence imposed on the slaves by the Dutch colonizers was never made publicly available in Europe since many of Merian's male contemporaries, such as Michel Descourtilz, "[stressed] the 'ill-intentions' of the 'negresses' who used them" (Schiebinger, 2004a, p. 3). In addition, since abortion was commonly practiced by midwives and women, to male physicians who were only called when the abortion went wrong "abortifacients appeared

dangerous" (Schiebinger, 2004a, p. 5). Obviously, they also gave women considerable freedom over their own bodies and reproduction, which threatened male authority and control. Furthermore, it is remarkable that Merian was even able to make this voyage with her daughter since there was an "often-expressed fear that […] the intense African sun […] produced black babies regardless of the parents' complexion" and "that white women taken to warm climates succumbed to 'copious menstruations, which almost always ends […] in fatal hemorrhages of the uterus" (Schiebinger, 2004a, p. 4). These and other allegations about women's bodily fragility "[unmask] the claim the science is gender neutral and [underscore] how gender inequalities have been built into the production and structure of knowledge itself" (Schiebinger, 2004a, p. 2). [2]

As discussed, women have often been precluded from the sciences because of their perceived passivity and fragility. For example, women were not able to conduct any research that involved sexuality, including animal behavior, anatomy, etc., Kemp (2004) explains, "For centuries the study of flowers and the cultivation of gardens were deemed safe pursuits for young ladies. The behavior of animals, by contrast, was too likely to provoke difficult questions about sexuality" (p. 48). Yet in 1751, Carl Linnaeus' publication, *Philosophica Botanica* brought the study of plants into question for women as well because of his "sexual system [of] classification […] based on stamens and pitons" (p. 48). Furthermore, in 1797, Robert Thorton produced an illustrated book of Linnaeus' work including "romantic pictures of plants in evocative landscapes and highly charged allegories of nature" (p. 49). The "obscene" illustrations of the reproductive organs of plants distressed the religious and conservative groups of the time who warned against exposing young women to his work (p. 49).

As mentioned before, when some of the historical connections in Western art and science are examined, the ways in which visual imagery inscribes gender onto bodies and society becomes apparent. For instance, in 1899 Louis-Ernest Barrias completed the sculpture *Nature Unveiling Herself Before*

[2] See Londa Scheibinger's book *Plants and Empire: Colonial Bioprospecting in the Atlantic World* for a more extensive analysis of gender, science, and abortifacients.

Science (Daston & Galison, 2007, p. 244). In this piece commissioned by the French government, a woman with her eyes turned down in modesty erotically reveals her breasts to the viewers. Feminist theorist Mulvey (1999) explains this phenomenon about visual representations of women, writing:

> In a world ordered by sexual imbalance, pleasure in looking has been split between active/male and passive/female. The determining gaze projects fantasy onto the female figure, which is styled accordingly […] with their appearance coded for strong visual and erotic impact so that they can be said to connote *to-be-looked-at-ness* (pp. 47-8).

In this sculpture, woman as nature is put on display to fulfill the desires of the (scientific) male gaze. Versalius' front piece to *Epitome* also exemplifies the passive display of the female body for the visual pleasures of science:

> The picture [is] […] an assertion of male power to know the female body and hence to know and control a feminine Nature. Vesalius presides here over an assemblage of men who peer into a woman's helpless, naked, and revealed body before them […] her generative organs more clearly shown, her face mysteriously veiled so as to emphasize the accessibility to her body to the male gaze (Laqueur, 1990, p. 73).

As such, nature and bodies are commonly confronted and known through dissections, which are made visible to the public through illustrations, photographs, and other forms of visualization. Yet the process of visualizing is not just about optics but is rather a gestalt, or way of seeing and representing the world (including sex and gender). A case in point is the portrayal of the vagina as an inverted penis or the one-sex model in which the male is the standard. This model of human genitalia was purported by Renaissance anatomists, such as Vesalius in *De humani corporis fabrica* [On the fabric of the human body] (1543). In the one-sex-model, men and women are understood as having the same sexual organ; the only difference was that the women's was on the inside. Yet after the Renaissance, the two-sex model displaced this older model. Furthermore, in the two-sex model, many scientists argued that sexual organs (or more currently, genetics) dictate gender behavior and, thus, justify precluding women from the sciences. For instance, the medical philosopher, Pierre Roussel argued in 1803 that "The soft parts which are part of the female constitution […] also manifest differences which enable one to catch a glimpse of the functions to which woman is called, and the passive state to which nature has destined her" (in Jordanova, 1989, p. 27).

Even though it seems these ideas from the past about sexual difference have little influence on current conceptions of gender, these essentialist arguments are still being perpetuated. For instance, Lawrence Summers, the former President of Harvard, insinuated that women do not have the same innate ability as men in the sciences during a speech he gave at a conference. He asserted, "Research in behavioral genetics is showing that things people previously attributed to socialization weren't due to socialization after all" (Bombardieri, 2005, p. 1). So, the technologies of gender "the process of 'bringing forth" or '[making] something appear […] has produced the conditions of women in the sciences today" (Ahmed, 2007, p. 46). It is not that women were/are not orientated for science, since women, such as midwives, have been practicing and passing down scientific knowledge for centuries. In fact, they often surpassed the skills of the men, which was often why they were considered "witches". Rather much of Western science has othered and objectified women's bodies and creating an inhospitable environment for women. As Ahmed (2006) writes, "Objects, as well as spaces, are made for some kinds of bodies more than others" (p. 51). [3]

6. Racism, Orientalism, and Imperial Power

Like with any discipline, it impossible to think about biological science or nature without understanding the racial and sexual histories of Western culture. For instance, as with women, nature has also been used as a rationalization for the exploitation and oppression of Third-world, the global south and indigenous people. Contemporarily, Western culture is still fascinated with using visuality as a model for representing and constructing notions of difference and creating binaries divisions between civilized/primitive and nature/culture. For instance, in the popular magazine *National Geographic,* photography is commonly used to reveal the "otherness" of indigenous people to curious Western consumers. For example, in a photograph by Dan Westergren (2009), the Maasai tribesmen are shown inspecting the photographer's camera (which is used as a symbol of Western culture), and this juxtaposition

[3] For a more thorough discussion of the implications of Western science on women see Londa Schiebinger's book *Nature's Body: Gender in the Making of Modern Science* (2004b).

is meant to cast the tribesman as the "primitive" other. Furthermore, in the photograph of the Vhevenda tribe virgins in South Africa, Jeff Hutchens (2004) portrays the women as sexual objects for the Western male gaze by erotically focusing on their buttocks and cutting off the other parts of their bodies. This focus on portraying Third-World and indigenous "difference" and putting the people of color on display is not new to Western culture. One of the most notable examples in this horrendous history is the story of Saartjie Baartman, who was known as the Hottentot Venus. Saartjie Baartman was a slave from the Khoikhoi tribe, who was taken from her home in South Africa and brought to England in 1810 and later to France. In England and France, she was forced to reveal her nude body to Europeans fascinated by her large buttocks and elongated labia. During these exhibitions, multiple illustrations of her body were created and circulated throughout Europe, often using her body as scientific proof of the inferiority and uninhibited sexuality of Africans. Gilman (2003) writes:

> Buffon commented on the lascivious, apelike sexual appetite of the black, introducing into a commonplace of early travel literature into a "scientific" context. He stated that this animal-like sexual appetite went so far as to lead black women to copulate with apes […]The black [woman] occupied the antithetical position to the white on the scale of humanity […]The antithesis of European sexual mores and beauty is embodied in the black, and the essential black, the lowest rung on the great chain of being, is the Hottentot (p. 139).

Only five years after being taken from her home, examined, and exhibited all over England and France, Saartjie died at age twenty-six. Saartjie was not the only non-European to be exhibited and studied for Western entertainment and "scientific" pursuits. In the nineteenth and twentieth-centuries, many other ethnic were put on display in zoological gardens, where they were fenced in like animals in order to stress their "exotic otherness" and demonstrate the "superiority" of white Europeans and the inferiority of black Africans and "explained the Europeans' right to conquest and rule as well as their exploitation and oppression of the Africans" (Jonassohn, 2000, p. 40). The tragic story of Saartjie Baartman and the others displayed in human zoos reveal how racism and orientalism connect through imperial science in Early Modern Europe:

> the pursuit of imperial power and the desire for domination over nature and peoples and their exploitation for income is integral to the construction of a new mode of relationality; one that stressed eye witnessing, close observation, group judgment and evaluation of information, and the disciplining of subjects (Smith, 2002, p. 17).

Furthermore, illustrations by European naturalists created a new sort of commodity fetish in Europe. People had a thrust for knowledge about the unknown, and the paintings and drawings by naturalists and explorers served as a mark of power over nature and people, which made the "exotic" imagery widely coveted. For instance in 1515, three-hundred years prior to Saartjie Baartman being taking from her homeland and exhibited, the painter, printmaker, and theorist Albretch Dürer created a woodcut of an Indian rhinoceros that belonged to a powerful King of Portugal, Manuel of Lisbon. Even though he had never actually seen the rhinoceros and his illustration was anatomically incorrect, his drawing was believed to be an accurate representation of a rhinoceros and was widely reproduced for centuries. As Smith (2002) states, Dürer's representation "[articulates] the importance of art in rendering knowledge visible for an audience fascinated by nature […] They needed to see these strange and different things in order to comprehend them fully" (p. 7). Dürer fulfilled the public's desire to see an exotic animal and get a glimpse of "the Orient" —commonly thought of as "not Europe" and romanticized as mysterious and sensual (Ahmed, 2007, p. 114). As post-colonial theorist Said writes in *Orientalism* (1977), "The Orient was almost a European invention and been since antiquity a place of romance, exotic beings, haunting memories and landscapes, remarkable experiences" (p. 1).

As discussed with da Vinci's *Vitruvian Man*, Albretch Dürer also "shared with Leonardo the quest for an art that would be 'universal'; that is to say, one that constructs representations of all forms in nature on the basis of a profound understanding of natural philosophy" (Kemp, 2004, p. 14). Kemp continues, "When portraying human beings, Dürer considered that the mental and physical constitutions of each individual were to be systematically expressed in terms of Renaissance theories of psychology and physiology" (p. 14). It is common practice in Western science to use the body as a sign of the "nature" of humanity. Kemp expounds upon Dürer's views on physiognomy (the study of personalities via physical features of the body), by explaining the profound impact that Dürer's characterization of individual temperaments based on human proportions had on "not only on physiognomics but also on nineteenth century sciences of phrenology, craniologist, and eugenics" (p. 15). He continues to assert the remnants of

these observations are still experienced stating, "We all act as amateur physiognomists, however often our initial reaction to someone's 'look' is confounded" (p. 15) and almost 500 years later, little has changed. For instance, the ABC news shows *Good Morning America* provides one contemporary example of the insights of physiognomy in a segment that claimed that the shape of one's nose could reveal one's dominant personality traits (Goodman, 2008). This is similar to the claims made by mid-1800s anthropometric proponents who claimed the measurement and mapping of the human face determined intellect, which had disastrous gendered and racial implications. Yet, like in much of Western science, what this ABC segment (Goodman, 2008) really purported was racial stereotypes disguised as scientific fact. For example, the segment aligned having a bulbish-tip nose with having a preoccupation with saving. So, in other words, one could take this inference to mean that if you have a Jewish nose, then you must be "cheap". This study is simply a scientific ruse to reinforce racist and anti-Semitic stereotypes and make Jewish people feel guilty for any form of success they achieve (which has often led many Jewish people, particularly women, to undergo plastic surgery to "fix" their noses). In addition, the segment also maintained that having a broad nose means that one has a powerful sex drive, which, just like the colonial scientists' racist claims, associates people of African descent with sexual promiscuity and danger. Nonetheless, many of the viewers of this show may have believed this "research" on noses, just like people believed Dürer's rhinoceros was anatomically correct in nineteenth-century Europe.

7. Eugenics, Queer Bodies, and Disability

The word "eugenics" comes originates from Greek words "eu" (well) and "genes" (born) and promotes the idea of a superior humanity by preventing "undesirable" people from procreating or being born. People have been conditioned to react to people who seem foreign or "other" from themselves with a mixture of fear and fascination. As Audre Lorde (2005) writes, "We have no patterns for relating across our human differences as equals. As a result, those differences have been misnamed and misused in the service of separation and confusion" (p. 338). This section discusses how human differences have been

used in eugenic practices and how these practices relate to disability and queer[4] politics in the past and present. The term eugenics refers to a set of beliefs about the ideal human form and sets up different ways of achieving this goal in different historical locations. As feminist theorists Araujo & Sommer (2002) explain, "Eugenic practice includes the systematic elimination of so-called 'undesirable' biological traits and the use of selective breeding to 'improve' the characteristics of an organism or species" (p. 165). They continue, "One branch of eugenics held that the rich and powerful were genetically superior to the poor, and that whites were in general superior to other races. Such a philosophy has provided a convenient justification for a system of structuring inequalities" (p. 165). The branches of eugenics discussed here claim that one sexuality, body type, and ability status is superior to other sexualities, body types, and ability statuses and that anyone who does not meet these standards should be eliminated.

With scientific authorities asserting such dangerous claims, it is no surprise that the British anthropologist Sir Francis Galton developed the field of eugenics in 1883, which quickly spread to the United States (where it was advocated by prominent men such as Carnegie). In the early 1900s, eugenics was already becoming a major force in U.S. social policies, and by 1907 "sixteen states [had adopted] sterilization laws for 'socially inadequate biological varieties'" (Araujo & Sommer, 2002, p. 165). Furthermore, eugenicists' in Nazi Germany from the 1920s were citing the U.S. as a source of inspiration for their eugenic practices:

> a leading advocate of eugenics in Germany at the time remark[ed], 'What we racial hygienists promote is not at all new or unheard of. In a cultural nation of the first order, the United States of America, that which we strive toward was introduced long ago' (Araujo & Sommer, 2002, p. 166).

Along with atrocities suffered by the Jews, Poles, and Gypsies, homosexuals and the disabled were also among the eleven to twenty-one million people to be tortured and slaughtered by the Nazis, and even

[4] Like Ahmed (2007), this paper employs the word "queer" for several reasons: "First, I [use] 'queer' as a way of describing what is 'oblique' or 'off line'" (p. 161). Likewise, the term "queer" is used "to describe specific sexual practices. Queer in this sense would refer to those who practice nonnormative sexualities (Jagose, 1996), which as we know involves a personal and social commitment to living in an oblique world" (p. 161). In other words, queer to refer to those who deviate from societal norms, particularly in regards to sexuality, and celebrate their existence on the margins.

after the liberation of the Nazi death camps, homosexuals were then forced into military prisons. Furthermore, the Nazis also often constructed racist and ableist visual illustrations and diagrams of Jews and the disabled and taught this propaganda as scientific fact in children's textbooks and to the general population (Ritter, 2019).

Like the Jews, in these eugenic discourses, homosexuals and the disabled were often referred to as lower beings on the evolutionary chain, much like non-Europeans and the lower classes (both in the US in the 1900s as well as in Nazi Germany in the mid-1900s). By dismissing "queers" and "crips" in this way, scientists legitimized scrutinizing their bodies, locking them up in hospitals and jails, and attempting to eliminate them from society while maintaining the European upper-class, heterosexual, able-bodied male as the pinnacle of humanity. Consequently,

> The bodies and behaviors of prostitutes, thieves, vagabonds, and the 'feebleminded' were examined, measured, and classified as evolutionary throw-backs or degenerates […]What they were presumed to share with other atavistic groups, including people of non-European origins and animals, were biologically innate and inherited characterizes that placed them on a lower rank in the order of human beings (Terry, 1999, p. 32).

Furthermore, even early-twentieth century women's suffragists were linked with criminals (and thus "degenerates"), and in 1869 the German physician Karl Westphal expressed a similar theory about people with "contrary sexual instinct[s]" (Terry, 1999, p. 32). As feminist theorist Terry (1999) reveals, "During the second half of the nineteenth century […] the homosexual was viewed as having many of the same characteristics that distinguished 'primitive' races from their 'advanced' European heterosexual counterparts, namely degeneracy, atavism, regression, and hypersexuality" (p. 36). In addition, people with disabilities were also conflated with other "sub-standard" humans, such as homosexuals and non-Europeans. For instance, in 1867, just two years before Westphal theorized about the primitiveness of sexual 'deviants', the German scientist Carl Vogt made a similar allegation about developmentally disabled people. He wrote, "Microcephalics represent an earlier developmental state of human being […] they reveal to us in of the milestones which human passed by during the course of his historical evolution" (in Clare, 1999, p. 80).

Likewise, in the U.S. eugenics was used as justification for the sterilization of around 60,000 number of disabled individuals and people of color in the early to mid-1900s (Stern, 2021, p. 1). Even Margaret Sanger, a feminist who is celebrated for being a pioneer for women's reproductive choices, used eugenics as a way to legitimate birth control; she claimed that it would allow "more children from the fit and less from the unfit" (Araujo & Sommer, 2002, p. 166). Thus, considering this history, it is no surprise that the term eugenics is met with much fear and animosity currently, yet the practices of early eugenicists continue, hiding under the guise of genetics and new reproductive technologies. For example, to this day, donated eggs and sperm are assiduously screened, and the more desirable the characteristics of the donor (in relation to the intelligence, looks, etc.), the more money the "sperm" and "eggs" are worth. Moreover, gay men and disabled individuals are not permitted to donate sperm or eggs. In addition, a prenatal mother can also opt to undergo genetic screening to see if the fetus is at risk of developing a disability. Since a mother can screen for genetic predisposition for disabilities in a fetus, could mothers screen for a homosexual predisposition as well if scientists located a "gay gene". Realities such as these reveal why "queers" and "crips" have developed counter-identities that resist the bigotry of mainstream culture. As queer and disability theorist Eli Clare (1999) proclaims, "*Queer* and *cripple* are cousins; words to shock, words to infuse with pride and self-love, words to resist internalized hatred, words to help forge a politics" (p. 70).

As with gender and race, visuality is used to "prove" the "inferiority" of homosexuals as well. As Terry (1999) writes, "Through techniques of clinical surveillance and diagnosis, homosexual bodies […] were the objects to be measured, zones to be mapped, and texts to be interpreted" (p. 41). For instance, in 1935, the city of New York completed a scientific study on homosexuality called "The Committee for the Study of Sex Variants" (Terry, 1999, p. 178). This study attempted to uncover the "truth" about homosexuality and prove the "perversity" of the growing homosexual population in New York. The study was conducted through a variety of methods including photography, psychoanalysis, endocrinology, and psychometric testing (a newer version of anthropometrics theories), and the subjects consisted of volunteers who were self-avowed homosexuals, both men and women (Terry, 1999, p. 178). In the study, one of the

scientists, Robert Dickinson, strove to prove that there was a biological basis for homosexuality, including differences in the genitals of heterosexuals and homosexuals: "Dickinson's sketches illustrate how scientific practices of close observation and detailed recording bolstered the authority of the study's scopic regime" (Terry, 1999, p. 203). Terry discusses how Dickinson had claimed that lesbians manifested "abnormal" female genitalia:

> Regardless of the absence of a heterosexual control group, ten typical characteristics of lesbians were established, which […] distinguished their genitals from those of "normal women." […] Pejorative adjectives such as wrinkled, thickened, and protruding connoted excess [and hypersexuality] and literally marked the subjects as pathological, while the normal unmarked female was represented in unmodified terms (Terry, 1999, p. 203).

Much like in the truth to nature regime, many of the generalizations made by Dickinson on the physical characteristics of homosexuals were not consistent within his study, yet "in an attempt to draw composite sex variant body, variations among subjects were homogenized in favor of a stereotypical construction of sexual inversion" (Terry, 1999, p. 210).

Unlike Dickinson who searched for the biological roots of /sexual variance' through reproductive organs, many scientists today are still searching for the "cause" of homosexuality through the study of genetics and the brain. For instance, in 1993 Simon Levay, a self-proclaimed homosexual neuroscientist from the Salk Institute in San Diego, California wrote the book *The Sexual Brain* where he claims to have found structural differences in the brains of homosexual and heterosexual men (Nimmons, 1994, p. 1). He conducted post-mortem examinations on brains, asserting a region of the brain called the interstitial nuclei of the anterior hypothalamus is on average two or three times bigger in heterosexual men than it is in women (Nimmons, 1994, p. 1). However, his study also had limitations, most notably that he conducted most of his exams on men who had died of AIDS and did not find the same biological evidence for homosexuality in women (Nimmons, 1994, p. 1). Likewise, before Dickinson and Levay even began their research, European scientists also often cited the brain as the biological root of homosexuality. For example, in 1886, the German psychiatrist Kraft-Ebing claimed that homosexual degeneration started in the brain and nervous system (Terry, 1999, p. 46). As Terry asserts:

> Scientific claims that European gentleman had larger brain sizes than both their female counterparts and savage men appeared about the same time that scientists noted the extraordinary large penises of primitive men…homosexual men were imagined as embodying the worst of both savages and women; while they were insatiable in their sexual pursuits and frivolously emotional, they lacked the modesty of bourgeois women and the primal strength of savage men" (1999, p. 35).

Hence, in the history of Western culture, homosexuals have been figured as either diseased beings (who should be pitied not criminalized), amoral criminals (who should be locked up), or as degenerates (who should be eliminated), which still affects current research about the "causes" of homosexuality today.

Much like in the human zoos, people with disabilities were also exhibited in dehumanizing ways:

> The history of freakdom extends far back into western civilization […]During [the mid-1800s to mid-1990s], freak shows populated the United States […]They came to gawk at freaks, savages, and geeks […]They came to have their ideas of normal and abnormal, superior and inferior […] confirmed and strengthened […] Disabled people, both white people and people of color, became Armless Wonders, Frog Men, Giants, Midgets, Pinheads, Camel Girls […]and the like (Clare, 1999, p. 71).

Moreover, during these freak shows, eugenic discourses were often espoused, and individuals with diseases, genetic variations, or other marks of "difference" were displayed as nature's mistakes. However, one should not completely dismiss the agency of participants in these shows. As Clare (1999) illustrates, "Like prostitutes, the people who worked as freaks—especially those who had some control over their own display—grasped an exploitative situation in an exploitative world and […] turned it to their benefit" (p. 79). Thus, no matter how insignificant it may seem, the moments of subversion, resistance, and agency should not be ignored or dismissed. He writes, "When a people's collective history includes dehumanizing medical textbook photographs, forced sterilizations, pity fests masquerading as charity, and an asexuality so deeply ingrained into our bodies and institutionalized in the world that it feels impossible to shake" (1999, p. 116), those moments and acts of resistance are sometimes the only things that get people through. For example, in the mid-1800s, B. Frank Palmer, an amputee from childhood, designed his own prosthetic leg because he was disgusted with the simple "peg leg" that he had worn since childhood. He created a complex knee joint with pulleys and springs allowing the amputee to walk more naturally (Mitchell & Snyder, 2000, p. 80). Through his invention, he both normalized himself by creating a more "natural" walking leg and resisted the stereotype of the dependent and powerless disabled person, which has provided

amputees (if they can afford it) with the ability to choose from an array of prosthetics limbs in different colors and styles, including bionic and computerized to limbs. Clare (1999) reflects,

> I think of the words *crip, queer, freak, redneck.* None of these are easy words. They mark the jagged edge between self-hatred and pride, the chasm between how the dominant culture views marginalized peoples and how we view ourselves, the razor between finding home, finding our bodies, and living in exile (p. 11).

In such, scientific knowledge and its representations affect the material reality of those adjected from the hegemonic culture and how these people view themselves and their own worth. Accordingly, this provides great responsible to correct representations of the past and provide new understandings of difference outside the discourse of superiority and inferiority.

8. Bridging the Divide: Visions for The Future

In sum, this critical biography has exposed an idealization of a particular and exclusionary "liberal human subject" that has been upheld in various historical moments in Western art and science. In the moments of intersection revealed in this paper, Western art and science have worked together to "prove", often visually, the inferiority of women, people of color, queer people, and people with disabilities who have been relegated to the non-human, the almost human, the monstrous, or the animal. Currently, a new ever-evolving, heterogenous, scientific-artistic paradigm exists which still carries the legacy of its past but also breaks from it in many ways. In this current epistemic shift, science and art seem less concerned with "revealing" inferiority of other humans "objectively" but many manifestations of science/art are still involved in the co-creation of an idealized "perfection" of human subjects through genetic modification (including art that engages with science and technology and that which critiques/questions it from an ethical standpoint). As new cloning, robotic, and gene-altering technologies are being produced, they raise new ethical questions for delimiting and defining the human and the non and/or sub-human which affect art, science, philosophy, politics and societies. For instance, in April 2021, scientists successfully created human-monkey embryos in the United States (Subbaraman, 2021) and, in 2017 in Saudi Arabia, a robot

named Sophia was given citizenship (Katz, 2017), both of which introduce complex questions about human rights. On the other hand, in 2020, the MoMA, held an "immersive experience of somatic, auditory and visual engagement" combining art and neuroscience so people could reflect upon "issues around racial justice, climate change, and the ongoing pandemic" and "to highlight the importance of exercising our agency to vote" (p. 1). As such, in this new epistemic paradigm, scientists no longer perform live vivisections to show "veracity" but instead mutate pig genes to make them glow in the dark (Ramprasath, 2013) or create rats that can grow human ears (Briggs, 2013). For instance, the 2019 Netflix documentary *Unnatural Selection* (Kaufman & Engender) highlights new technologies in genetic engineering, their potentials and dangers, and discusses how bio-hackers struggle to increase access to these technologies so anyone can practice genetic engineering merging art, science, and visual culture once again. In this, the creative and dynamic potential between art and science can inextricably alter the world yet whether positively or negatively depends on where the power is situated to create and employ these resources. It is precisely by exposing the shaky ground and imagined boundaries that many tenets of liberal humanism are founded upon that enables feminist scientists, historians, and artists to subvert current constructions of humanism and produce more favorable constructions in their place. As feminist scientist Deboleena Roy writes in *Molecular Feminisms* (2018):

> Doing science in our backyards could include setting up local science shops where experts from a diverse range of knowledge bases come together, through a shared common interest, to solve local problems. It could involve creating feminist, postcolonial, and decolonial technoscience salons where academics learn to bring their research into interdisciplinary conversations. It could involve creating shared community maker spaces that prioritize the involvement of typically marginalized groups. It could even involve setting up interdisciplinary mentoring structures that support the radical act of having feminist scientists practice both their science and their feminism at the lab bench (p. 206)

Hence, feminists can with science and art as critical political projects with transformative and liberatory potential or they can be used to reify and augment power practices already in play. In sum, drawing attention to the fact that "the human" has been a shifting and unstable signifier reveals how "the human" (in its current incarnations) has never and still does not exist, opening up new possibilities for

formulating how humanity is defined and where, when, and how boundaries are drawn. As feminist/queer theorists Halberstam & Livingston (1995) write,

> The human functions to domesticate and hierarchize difference within the human (whether according to race, class, gender) and to absolutize difference between human and nonhuman. The posthuman does not reduce difference-form-others to difference-from-self, but rather emerges in the pattern of resonance and interference between the two (p. 10).

The question humanity must answer is the signification of the "post": does it, like Halberstam & Livingston posit, mark a rupture from humanism and offer hope for more equitable configurations? Or is it simply continuation and amplification of the story of Man already told? Perhaps, it is a combination: a future already passed and yet to be written.

Bibliography

Ahmed, S. (2007). *Queer phenomenology: Orientations, objects, others*. Durham, NC: Duke University Press.

Araujo, E., & Sommer, L. (2002). "A summary of the history of eugenic theories and practices in the United States". In Fernandez, M., Wilding, F., & Wright, M. M. (Eds.) *Domain errors: Cyberfeminist practice*. (pp. 165–169). New York, NY: Autonomedia Press.

Barrias, L. (1899) Nature unveiling herself before science, [Tinted marble, onyx, red Pyrenees stone and malachite]. Musée d'Orsay, Paris, France.

Begley, S. (2001). The Science Wars. In Bartcsh, I. & Lederman, M. (Eds.). *The Gender and Science Reader*. (pp. 115-119). New York, NY: Routledge.

Bombardieri, M. (2005, January 17). *Summers' remarks on women draw fire.* The Boston Globe. https://www.boston.com/news/local/articles/2005/01/17/summers_remarks_on_women_draw_fire/.

Briggs, H. (2013, July 31). *Artificial human ear grown in lab.* BBC News. https://www.bbc.com/news/health-23508688

Clare, E. (1999). *Exile and pride: Disability, queerness, and liberation*. Cambridge, England: South End Press.

Daston, L., & Galison, P. (2007). *Objectivity*. Cambridge, England: The MIT Press.

Da Vinci, L. (1487). *Vitruvian man* [Ink on paper]. Gallerie dell'Accademia, Venice, Italy.

Edgerton, S. (1985) "The renaissance development of the scientific illustration". In Shirley, J. & Hoenger, D. (Eds.). *Science and Arts in the Renaissance*. (pp. 166-197). Cranbury, NJ: Associated University Press.

Foucault, M. (1977) "Nietzsche, Genealogy, History." In Bouchard, D. (Ed.) *Language, Counter-Memory, Practice* (pp. 165-96). New York, NY: Cornell University Press

Gilman, S. (2003). "Black bodies, white bodies: toward an iconography of female sexuality in late nineteenth-century art, medicine, and literature." In Jones, A. (Ed.). *The Feminism and Visual Culture Reader* (pp. 136-150). New York, NY; Routledge.

Goodman, R. (Producer). (2008, October 17). *What does your nose say about you?* [Television series episode]. In Good Morning America. New York City, NY: ABC News.

Halberstam, J. & Livingston I. (1995). *Posthuman bodies*. Indianapolis, ID: Indiana University Press.

Haraway, D. (1997). *Modest_Witness@Second_Millennium FemaleMan©_Meets_OncoMouse™*. New York, NY: Routledge.

Haraway, D. (1988). "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective" In *Feminist Studies*, *14*(3), p. 575.

Jones, A. (2003). *The feminism and visual culture reader*. New York, NY: Routledge.

Jordanova, L. (1989). *Sexual visions: Images of gender in science and medicine between the eighteenth and twentieth centuries*. Madison, WC: University of Wisconsin Press.

Jonassohn, K. (2000). *On a neglected aspect of western racism.* Montreal: Montreal Institute for Genocide and Human Rights Studies.

Hutchens, J. (2004). Vhevenda tribe virgins dance the serpentine domba Dance. [Photograph]. National Geographic.

Katz, B. (2017, November 02). *Why Saudi Arabia Giving a Robot Citizenship Is Firing People Up?* The Smithsonian Magazine. https://www.smithsonianmag.com/smart-news/saudi-arabia-gives-robot-citizenshipand-more-freedoms-human-women-180967007/

Kaufman, L., & Engender, J. (Directors). (2019). *Unnatural Selection* [TV series]. Netflix.

Keller, E. F. (2001). "Secrets of god, nature, and life". In Lederman, M. & Bartsch (Eds.), I. *The gender and science reader*. (pp. 98-110). New York: Routledge.

Kemp, M. (1992). *The science of art optical themes in western art from Brunelleschi to Seurat*. New Haven, CN: Yale University Press.

Kemp, M. (2004). *Visualizations: The nature book of art and science.* Oxford, England: Oxford University Press.

Laqueur, T. (1990) *Making sex: Body and gender form the Greeks to Freud*. Cambridge, MS: Harvard University Press.

Lederman, M. & Bartsch I. (2001). "Creating Androcentric Science". In Letterman, M. & Bartsch, I. (Eds.) *The Gender and Science Reader*. (pp. 63-67). New York, NY: Routledge.

Lorde, A. (2005). "Age, Race, Class and Sex: Women Redefining Difference". In Kolmar, W. & Bartkowski, F (Eds.). *Feminist Theory: A Reader*. (pp. 337-341). New York, NY: McGraw Hill.

Merchant, C. (2001). "Dominion over Nature". In Letterman, M. & Bartsch, I. (Eds.). *The gender and science reader*. (pp. 67-81). New York, NY: Routledge.

Mitchell, D. & Snyder, S. (2000). *The body and physical difference: Discourses of disability*. Ann Arbor: The University of Michigan Press.

MoMA. (2020, October 22). *The Art and Science of Hope and Justice.* MoMA. https://www.moma.org/calendar/events/6745

Mulvey, L. (1999). "Visual Pleasure and Narrative Cinema". In Baudy, L. & Cohen, M. (Eds). *Film theory and criticism: Introductory readings* (pp. 833-44). New York, NY: Oxford.

Ortner, S. (2000). "Is Female to Male as Nature Is to Culture?" In Kolmar, W. & Bartkawsly, F. (Eds.). *Feminist Theory: A Reader* (pp. 243-252). Boston: McGraw Hill.

Ramprasath, R. (2013, December 29). *Pigs glow green in dark, thanks to cytoplasmic injection reproductive technique*. TrackTec. http://www.tracktec.in/2013/12/pigs-glow-green-in-dark-thanks-to-cytoplasmic-injection-reproductive-technique.html

Ritter, S. (2019). "Indoctrinating German Youth: Children's Stories and Textbooks as Propaganda in the Third Reich". Ursidae CO: The Undergraduate Research Journal at the University of Northern Colorado, *8*(1). https://digscholarship.unco.edu/urj/vol8/iss1/17

Roy, D. (2018). *Molecular feminisms: Biology, becomings, and life in the lab*. Seattle, WA: University of Washington press.

Said, E. (1977) *Orientalism: Western Conceptions of the Orient.* New York, NY: Penguin.

Schiebinger, L. (2004a). *Feminist History of Colonial Science.* Hypatia. (Winter: 19.1) (pp. 233-55). Bloomington.

Schiebinger, L. (2004b). *Nature's body: Gender in the making of modern science*. Rutgers, New Jersey: Rutgers University Press.

Smith, P. (2002). *Merchants and marvels: Commerce, science, and art in early modern Europe*. New York, NY: Routledge.

Nimmons, D. (1994, March 1). *Sex in the brain.* Discover. https://www.discovermagazine.com/mind/sex-and-the-brain

Stern, A. (2021, March 24). *Forced sterilization policies in the US targeted minorities and those with disabilities – and lasted into the 21st century.* The Conversation. https://theconversation.com/forced-sterilization-policies-in-the-us-targeted-minorities-and-those-with-disabilities-and-lasted-into-the-21st-century-143144

Subbaraman, N. (2021, April 15). *First monkey–human embryos reignite debate over hybrid animals.* Nature. https://www.nature.com/articles/d41586-021-01001-2

Terry, J. (1999). *An american obsession: Science, medicine, and homosexuality in modern society.* *Chicago*: The University of Chicago Press.

Wilding, F. (2003). "Next Bodies". In Jones, A. (Ed.) *The feminism and visual culture reader* (pp. 26-29). New York, NY: Routledge.

Vesalius, A. (1543). *De humani corporis fabrica.* Palo Alto, CA: Octavo.

Westergren, D. (2009). Maasai Tribesmen Inspect Dan Westergren's Camera [Photograph]. National Geographic.