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# Body, Blood, and Flood: The Ripple of Kinesics through Nature in Leonardo da Vinci's Art

Rachael Herrera  
*Scripps College*

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BODY, BLOOD, AND FLOOD:  
THE RIPPLE OF KINESICS THROUGH NATURE  
IN LEONARDO DA VINCI'S ART

by

RACHAEL HERRERA

SUBMITTED TO SCRIPPS COLLEGE IN PARTIAL FULFILLMENT  
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## Chapter 1. Art, Science, and Philosophy Before Leonardo

Leonardo da Vinci said, “Study the science of art. Study the art of science. Develop your senses – especially learn how to see. Realize that everything connects to everything else.” Leonardo da Vinci is thought to be one of the greatest artists of the Renaissance, but he is also considered the father of modern science. As a quintessential “Renaissance man” Leonardo had interests across many fields but he integrated these subject together instead of studying them separately. Leading scholars on Leonardo emphasize that to understand his art one must understand his science and vice versa, but to simply study one while keeping the other in mind is not enough because they each inform the developments of the other.<sup>1</sup> Art and science both advance through Leonardo’s interest in nature and his desire to understand how it works. The evolution of Leonardo da Vinci’s work begins with existing ideas about the individual and the artistic style in the 15<sup>th</sup> and 16<sup>th</sup> century. Leonardo’s style was a product of his time as these philosophies provided a base for his ideas about the body. Although many artists were concerned with the physical appearance of a person, Leonardo, fed by his fascination with nature, turned to the body as a source of information about the physical world and the divine world. This new source of knowledge changed Leonardo’s ideas about how the individual is connected with the world and, in turn, affected his art.

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<sup>1</sup> Kenneth Clark, *Leonardo Da Vinci An Account of His Development as an Artist*, 2nd ed. (Cambridge: Brook Crutchley, University Printer, 1952), xiii., Charles Singleton, *Art, Science, and History in the Renaissance* (Baltimore: Johns Hopkins Press, 1967), 251.



This chapter covers the philosophical, artistic, and scientific ideas surrounding the body of the individual in relation to the universe during the 15<sup>th</sup> century and how Leonardo developed his initial style and interests in response. The next chapter, “The Body as Nature”, deals with how these preexisting ideas and theories influenced how Leonardo approached studying the body. Leonardo’s early knowledge was limited by his resources and the accepted ideas in the time and place he was living. Along with studying anatomy, Leonardo looked at how the soul interacted with the world through the body. Chapter 3, “The Body as Part of Nature”, deals with Leonardo’s increasing reliance on pure empiricism in his dissections. This resulted in a complete change in perspective on how the body interacted with nature. The last chapter, “Representations of the Body in Leonardo’s Art”, looks at this changing relationship between the body and the world through the lens of Leonardo’s art. This change in his style of study and the resulting new relationship between the body and the natural world is apparent through his art.

Much of what is known of Leonardo’s childhood is found in 16<sup>th</sup> century artist, architect, and historian Giorgio Vasari’s biography about him, and even so, little is known for certain about his early life.<sup>2</sup> Leonardo da Vinci was born in 1452 in the countryside village of Anachiano located near the town of Vinci, west of Florence. He was the illegitimate child of Ser Piero, a successful notary, and his peasant mother, Caterina.<sup>3</sup> Vasari reports that from a young age Leonardo was

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<sup>2</sup> Giorgio Vasari et al., *Lives Seventy of the Most Eminent Painters, Sculptures, and Architects*, vol. 2, 4 vols. (New York: Charles Scribner’s Sons, 1896).

<sup>3</sup>Clark, *Leonardo Development as an Artist*.

interested in nature and spent his time collecting animals and creatures to draw.<sup>4</sup> His 1473 drawing of the Tuscan landscape around the Arno valley (figure 1) reflects an early attraction to depicting the natural world through subjects such as botany, geography, and water. The sketch shows the movement of the Arno with its pools and waterfalls, an indication of Leonardo's interest in an active nature that moves in response to variables rather than just representing a static scene. Around 1469 Leonardo moved to Florence with his father and a few years later started his apprenticeship with the sculptor, painter, and goldsmith Andrea del Verrocchio.<sup>5</sup>

The work of Verrocchio had a large impact on Leonardo. As Verrocchio's shop assistant, Leonardo's foundation originated from Verrocchio's style and the pieces that were being created in his shop. Verrocchio was a Florentine artist and craftsman who accepted commissions that required a wide variety of skill and knowledge of different materials.<sup>6</sup> Vasari uses Verrocchio as an example of an artist who relied on his dedication and hard work as a way of progressing his pieces instead of relying on talent.<sup>7</sup> From a young boy Verrocchio studied math and science, which influenced his style of scientific naturalism. This empirical approach is evident through the physical and tangible nature of Verrocchio's work.<sup>8</sup> The variety of materials that Verrocchio worked with, from the copper topping of the

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<sup>4</sup> Vasari, *Lives of the Most Eminent Painters*, 378.

<sup>5</sup> W. R. Valentiner, "Leonardo as Verrocchio's Coworker," *The Art Bulletin* 12, no. 1 (1930): 43-89, doi:10.2307/3050761, 47. The dates when he moved to Florence and when he started in Verrocchio's workshop are highly contested. There is documentation showing that Leonardo moved to Florence with his father in 1469 but it is still unknown when he moves in with Verrocchio although it is known that he was admitted to the painters' guild in 1472, which he would only be admitted into after a few years of painting in a studio.

<sup>6</sup> Jill Dunkerton, "Leonardo in Verrocchio's Workshop: Re-Examining the Technical Evidence," *National Gallery Technical Bulletin* 32 (2011): 4-31.

<sup>7</sup> Vasari, *Lives of the Most Eminent Painters*, 238.

<sup>8</sup> Clark, *Leonardo Development as an Artist*.

Duomo to bronze and wax statues, was something that Leonardo was constantly exposed to.<sup>9</sup> This undoubtedly affected Leonardo's relationship with the physical world and how it is molded and represented through different mediums. Although Leonardo is known for his paintings and not statues, his apprenticeship exposed him to the sculptural work of Verrocchio.<sup>10</sup> Early in his career Leonardo drew many sketched of faces that clearly show influence from Verrocchio's sculptures.

Verrocchio's *Baptism of Christ*, commissioned by the monks of San Salvi between 1472 and 1475, is one of the first known paintings that Leonardo worked on (figure 2).<sup>11</sup> Vasari tells an anecdote about the angel on the left. He states that Verrocchio never painted again because Leonardo's angel was so superior to the rest of the piece.<sup>12</sup> Between the two angels, Leonardo's angel shows clear interest and mental engagement with the baptism and Verrocchio's angel looks off with a disengaged expression. Even within his first known piece, Leonardo shows interest in the active mind of the individual. There is evidence that Leonardo also painted some of the background and the water that Christ stands in.<sup>13</sup> The River Jordon cuts through the deep background with clear similarities to his Tuscan landscape study. The water that flows and ripples away from the ankles of Christ and St. John the Baptist is just the beginning of Leonardo's work and study of its movement.

Verrocchio's silver relief of *The Beheading of Saint John the Baptist* (figure 3) for the Silver Altar of the Baptistery shows the unique facial types that provide a

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<sup>9</sup> Clark, *Leonardo Development as an Artist*. Vasari, *Lives of the Most Eminent Painters*.

<sup>10</sup> Valentiner, "Leonardo as Verrocchio's Coworker", 45.

<sup>11</sup> Ibid.

<sup>12</sup> Vasari, *Lives of the Most Eminent Painters*, 376

<sup>13</sup> Dunkerton, "Leonardo in Verrocchio's Workshop", 6.

base for much of Leonardo's work.<sup>14</sup> Cartoons of facial types were a big interest of Leonardo's and he studied faces that had dramatic expressions and a wide diversity of features. Vasari writes, "Leonardo was so much pleased when he encountered faces of extraordinary character, of heads, beards or hair of unusual appearance, that he would follow any such, more than commonly attractive, through the whole day..."<sup>15</sup> Verrocchio's *Beheading of Saint John the Baptist* shows a youthful figure on the left side of the scene with his beautiful facial features in stark contrast with old warriors on the right. These comparative depictions of faces can be traced through Leonardo's sketches and into his major works such as his 1481 unfinished painting of *The Adoration of the Magi* (figure 4). Verrocchio's head types represent a common idea at the time known as physiognomy.<sup>16</sup> This was the idea that physical appearance was connected with internal character.<sup>17</sup> Facial types and structures were thought to be indicative of a person's internal state. These head types are visible in the early stages of Leonardo's art but advance into a central theme later on in his career as he develops his understanding of how internal and mental states are related and reflected as physical moments.<sup>18</sup>

As an apprentice, Leonardo was constantly around Verrocchio's sculptures and paintings, which characteristically have twisting and conflictual movement and is a clearly influential in Leonardo's development of movement, motion, and

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<sup>14</sup> Andrew Butterfield, *The Sculptures of Andrea Del Verrocchio* (Yale University Press, 1997), 105. Clark, *Leonardo Development as an Artist*, 7.

<sup>15</sup> Vasari, *Lives of the Most Eminent Painters*, 381.

<sup>16</sup> Maud Cruttwell, *Verrocchio* (Duckworth and Company, 1904), 16.

<sup>17</sup> Sandra Cheng, "The Cult of the Monstrous: Caricature, Physiognomy, and Monsters in Early Modern Italy," *Preternature: Critical and Historical Studies on the Preternatural* 1, no. 2 (2012): 197-231, 200.

<sup>18</sup> Martin Clayton, *Leonardo Da Vinci The Divine and the Grotesque* (London: Royal Collection Enterprises Ltd, 2002), 12.

curves. In addition to bodily movement, Verrocchio was also interested in the subsequent movement of cloth in response to actions of the body.<sup>19</sup> A physical manifestation of this theme is in the twisting and complicated intertwined cords that Leonardo drew while he was in Verrocchio's studio (figure 5).<sup>20</sup> This motion, learned while an apprentice, traces all the way through Leonardo's work in the form of knotted braids, swirling water, and turbulent winds.<sup>21</sup>

Another practice Leonardo learned from Verrocchio was to start internally and work outward. Regardless of the medium and final form, Verrocchio would spend time making the structure, whether it was wooden skeletons for his wax sculptures or drawing nude, undraped cartoons before painting the final image.<sup>22</sup> This early training Leonardo received emphasized the importance of the structure of figures even if they were to later be completely covered by other images in the painting or by drapery. Based on this framework, Leonardo developed techniques to realistically clothe his figures. Vasari reports that he would drape cloth dipped in plaster over sculptural figures and let it dry so he could sketch the drapery as it was struck by different lighting throughout the day.<sup>23</sup> Leonardo would later build off of this idea when studying the human body by working from the skeleton, to muscles, to skin in order to understand the movement of a body.

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<sup>19</sup> Jean K. Cadogan, "Linen Drapery Studies by Verrocchio, Leonardo and Ghirlandaio," *Zeitschrift Für Kunstgeschichte* 46, no. 1 (1983): 27-62, doi:10.2307/1482117, 30.

<sup>20</sup> Martin Clayton, *Leonardo Da Vinci The Anatomy of Man* (Boston: Museum of Fine Arts, 1992), 374.

<sup>21</sup> Ian M Clothier, "Leonardo, Nonlinearity and Integrated Systems," *Leonardo* 41, no. 1 (2008): 49-55.

<sup>22</sup> Vasari, *Lives of the Most Eminent Painters*, 243.

<sup>23</sup> *Ibid*, 372.

From an early age, while still in Verrocchio's studio, Leonardo showed a variety of interests from horses and the flight of birds<sup>24</sup> to hydraulic patterns, as evident in his suggestions for altering the course of the Arno.<sup>25</sup> These interests were fed by Verrocchio's tactile and empirical approach to art. It is often assumed that Verrocchio had the same training in anatomy as the average artists of his time, but Vasari writes that he studied the human body more in depth than others. Verrocchio was commissioned to restore the limbs of an ancient marble torso and was able to do so because of his knowledge of the body.<sup>26</sup> He also studied alongside Antonio Pollaiuolo who, according to Charles Singer in his essay *Notes on Renaissance Artists and Practical Anatomy*, was one of the first artists of the Renaissance who expressed a specific interest in movement of the human frame and one of the most influential anatomical artist before Leonardo.<sup>27</sup> He reportedly performed superficial dissections by opening up the skin of the arms and legs of bodies to look at the structures underneath.<sup>28</sup>

As Leonardo was learning about art as an apprentice in Verrocchio's workshop, the world around him was changing. The beginning of the Renaissance in the 15<sup>th</sup> century brought about new thought and philosophies about topics of interest to Leonardo and many arts of the time. Renaissance humanism

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<sup>24</sup> Vasari provides anecdotal stories of Leonardo buying birds from the market to simply release them back into nature and interprets these stories as proof of the love that Leonardo had for nature but other scholars see this as the beginning of Leonardo's interest and observation of birds' flight.

<sup>25</sup> Clothier, "Leonardo, Nonlinearity and Integrated Systems", 49.

<sup>26</sup> Vasari, *Lives of the Most Eminent Painters*.

<sup>27</sup> Charles Singer, "Notes on Renaissance Artists and Practical Anatomy," *Journal of the History of Medicine and Allied Sciences* 5, no. 2 (1950): 156–62.

<sup>28</sup> Alison Wright, *The Pollaiuolo Brothers: The Arts of Florence and Rome* (Yale University Press, 2005), 161.

reintroduced classical Greek and Roman philosophy that changed scholar's understanding of the relationship the human body had with the greater world.<sup>29</sup> Humanism had implications and connections throughout philosophy, medicine, science, and art: fields that were interwoven with Leonardo's work.

In addition to reemerging philosophies, other worldwide events contributed to a changing view of the world. The beginning of the Renaissance corresponded to a time of increased world exploration and expansion of international trade. Emerging Portuguese explorers like Prince Henry the Navigator began bringing back news of lands, such as parts of West Africa, where European explorers had not yet traveled.<sup>30</sup> Geographically the world was getting bigger than previously thought. With this expansion came new trade routes, which increased exposure to people, cultures, and goods. This new sense of adventure brought about prosperity as well as questions as to the role of the individual in the expanding world.<sup>31</sup> Did humans have a smaller role in this larger world or were they more important the larger their world was? These developments also opened up more questions as to the laws that

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<sup>29</sup>Alanna Speer, "How Did Christianity Become the Dominant Religion of the Later Roman Empire?," *History in the Making* 3, no. 2 (2014): 91–97., Robert L Cleve, "The Triumph of Christianity: Religion as an Instrument of Control," *Forms of Control and Subordination in Antiquity*, Leiden, Brill, 1988, 530–42. Classical philosophy disappeared with the fall of Paganism in Late Antiquity. In 313 with the Edict of Milan, Constantine the Great legalized Christianity and made the emergence of Abrahamic religions possible in the Roman State. Robert Cleve, in his paper *The Triumph of Christianity; Religion as an Instrument of Control*, states that the popular reasons for the rise of Christianity are that it was a "rational" theology whose promise of salvation was appealing to the masses. The highly organized hierarchy of the church had support from the government, which could use coercion to convert people from Paganism to Christianity.

<sup>30</sup> C. Raymond Beazley, "Prince Henry of Portugal and the African Crusade of the Fifteenth Century," *The American Historical Review* 16, no. 1 (1910): 11–23, doi:10.2307/1834305.

<sup>31</sup> Ivor B. Hart, "The Physical Science of Leonardo da Vinci: A Survey," *The Monist* 35, no. 3 (1925): 464–85.

governed this new earth, and for answers some turned to the internal workings of the human body.

Humanism, an emerging school of thought, began as the study of the humanities (*studia humanitatis*) as a means of understanding the ideas and teachings of classical antiquity. These areas of study included grammar, rhetoric, history, poetry, and moral philosophy.<sup>32</sup> Although humanism started as a specifically academic endeavor its greater purpose was to be applied to daily life. It was to function in a way that molded reason for daily life. This idea, often referred to as “self-fashioning”, merged the distinctions between social and cultural spheres,<sup>33</sup> which introduced a movement away from abstract philosophies that were purely theoretical and had no physical grounding or applications to life.<sup>34</sup> In turn, it resulted in an emphasis on intellectual ability and the capacity for any person to have an active mind.

Leonardo was specifically interested in the role of the body within the concept of the active intellectual. As a way of turning the mental expression of intellect into a physical movement Leonardo turned to body language as a mirror of cognition. He made it clear in his notebooks that the artist should be able to show emotion and character through visceral movements.<sup>35</sup> This approach to the representation of inner characteristics shows a break from previous ideas about physiognomy. Other artists believed that features represented internal character

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<sup>32</sup> Donald R. Kelley, *Renaissance Humanism* (Boston: Twayne Publishers, 1991), 74.

<sup>33</sup> John Martin, “Inventing Sincerity, Refashioning Prudence: The Discovery of the Individual in Renaissance Europe,” *The American Historical Review* 102, no. 5 (1997): 1309–42, 1314.

<sup>34</sup> Hanna H. Gray, “Renaissance Humanism: The Pursuit of Eloquence,” *Journal of the History of Ideas* 24, no. 4 (1963): 497–514, doi:10.2307/2707980, 501.

<sup>35</sup> Clayton, *The Divine and the Grotesque*, 12.



while Leonardo insisted that it was the mechanical movement of the body and facial expressions that portrayed the internal. This nuanced difference becomes crucial to Leonardo's later studies and interest in the body. Instead of superficial qualities that concerned most artists, Leonardo was interested in the deeper and internal structures that controlled movement such as facial muscles, tendons, and ligaments that moved joints.<sup>36</sup> Internal character manifests itself through Leonardo's caricature drawings and cartoons that he first learned in Verrocchio's studio (figure 6). These grotesques show their character through indications of facial movement. He believed that the face shows character, not in structure, but in response to how it is used to convey character.<sup>37</sup> Are there wrinkles around the eyes that show laughter or lines on the forehead that indicate worry? The intellect is actively displayed through movement in the face and body.<sup>38</sup>

This introspective look into the individual's intellect called into question the place of humanity in the physical world and the divine world. The humanist belief was that the soul, which is split into higher and lower parts, determines the space between these two realms the individual can occupy. The Lower Soul, closely related to the physical body, depends on the senses and physiology and is therefore fixed based on the physical. The Higher Soul, on the other hand, is made up of Reason and Mind, with Mind held superior to Reason. Reason concerns itself with material experiences while Mind is able to share experiences with the divine and

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<sup>36</sup> Clayton, *The Anatomy of Man*, 13.

<sup>37</sup> Clayton, *The Divine and the Grotesque*, 13.

<sup>38</sup> Michael W. Kwakkelstein, "Leonardo Da Vinci's Grotesque Heads and the Breaking of the Physiognomic Mould," *Journal of the Warburg and Courtauld Institutes* 54 (1991): 127-36, doi:10.2307/751484.

thus creates a bridge to higher notions.<sup>39</sup> By following a path led by the higher faculties of the Mind, individuals can elevate themselves closer to the divine, but by following the lower faculties of Reason, individuals will fall to the material where the more animalistic Lower Soul will take over. In his *Oration on the Dignity of Man*, Italian Renaissance philosopher, Pico della Mirandola, states, “The region above the heavens He had adorned with Intelligences, the heavenly spheres He had quickened with eternal souls, and the excrementary and filthy parts of the lower world He had filled with a multitude of animals of every kind.”<sup>40</sup> An important distinction here is that Humanism applied intellect to the daily life but not through experience.

Experience had implications with the material and Reason, so relying on intellect gained through experiences was a reliance on the Lower Soul. This philosophy that demoted reason below intellect naturally created tension between “hard sciences” and the humanities. In regards to the human body, people, caught between the earthly and divine, could be subjected to scientific study because of their place on earth but shared characteristics of god and therefore could also be subjected to theological interpretation.<sup>41</sup> This idea helped rationalize the connections scientific study of the body made to the souls place in the universe.

Although the soul was thought to reside between the divine and the worldly, Leonardo, in line with his interest in finding internal character through the body, was interested in where the soul resided within the body. In searching for the soul’s

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<sup>39</sup> Erwin Panofsky, *Studies in Iconology: The Humanistic Themes In the Art of the Renaissance* (New York: Oxford University Press, 1939), 136.

<sup>40</sup> Ernst Cassirer, Paul Oskar Kristeller, and John Herman Randall, *The Renaissance Philosophy of Man: Petrarca, Valla, Ficino, Pico, Pomponazzi, Vives* (University of Chicago Press, 2011), 224.

<sup>41</sup> Singleton, *Art, Science, and History in the Renaissance*, 241.

place in the body Leonardo had to trace it through physical properties like how it communicates with the sensual world.<sup>42</sup> While everyone else believed the Lower Soul to be connected with the physical, Leonardo, who connected the intellectual (what others connected with the Higher Soul) with physicality, believed that the whole of the soul resided amongst the senses. His pursuit to find the “seat of the soul” within the human body contributed to his interest in the anatomy of the body.<sup>43</sup> Through the physical body Leonardo believed that he could find the soul where the senses converged and, through this, a connection to the divine.

The relationship between the body and the greater world is described by Ernst Cassirer, in his book *The Individual and the Cosmos in Renaissance Philosophy*, was a basic motif in the Renaissance.<sup>44</sup> He refers to this theory as the motif of the “microcosm”. In the universe, or cosmos, there is the *macrocosmos* and the *microcosmos*.<sup>45</sup> The idea of this theory was that the body was the microcosm of the greater macrocosm that was the world. People worked to explain the world through their understanding of the body and vice versa. The systems that governed the physical world had control over the systems that made up the human body. This connected the study of the body with the study of the world, both the physical and divine.

This concept of the microcosm and macrocosm was a driving theme that not only encompassed Leonardo’s art but his studies across all fields. He applied his

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<sup>42</sup> Leonardo Da Vinci and Edward MacCurdy, *The Notebooks of Leonardo Da Vinci*, vol. 1 (New York: Reynal & Hitchcock, 1938), 119.

<sup>43</sup> Ibid, 181.

<sup>44</sup> Ernst Cassirer, *The Individual and the Cosmos in Renaissance Philosophy* (Courier Corporation, 2000), 109.

<sup>45</sup> Thomas Laqueur, *Making Sex: Body and Gender from the Greeks to Freud* (Cambridge: Harvard University Press, 1990), 115.

knowledge of the body to the earth and his knowledge of the earth to the body. In Leonardo's studies, particularly in his references to Ptolemy's *Cosmography*, he states that through relating divisions of the body to divisions within the earth he would be "able to reveal the nature of man and his customs".<sup>46</sup> The importance of this concept to Leonardo is apparent as it permeates his manuscripts on the body and the world. He correlates the world to the body by referring to rocks and mountains as bones and rivers and oceans as blood.<sup>47</sup> He also uses terms of nature to describe the body as present in his description of the circulatory system with the heart referred to as a nut that grows into a "Tree of the Vessels" with roots and the "ramifications of plants".<sup>48</sup> Not only analogous in structure and appearance, Leonardo believed the same laws of physics that govern the physical world also govern the internal structures and growth of the body.<sup>49</sup> This connection only strengthened Leonardo's interest in the human body because not only was it a way to become closer to the divine, but it was also a way for him to answer questions about the physical world he lived in.

The medical field at the time shows the integration of these philosophies about the body. Historian Thomas Laqueur, in his book *Making Sex, Body and Gender from the Greeks to Freud*, repeatedly indicates that doctors turned to this micro/macrocosm theory for explanations of ailment.<sup>50</sup> Within this theory they were particularly interested in the zodiacs and the relation of the body to the

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<sup>46</sup> Kemp, *The Marvelous Works of Nature and Man*, 94. Da Vinci, *The Notebooks of Leonardo Da Vinci*, 169.

<sup>47</sup> Ibid.

<sup>48</sup> Ibid, 126., Clayton, *The Anatomy of Man*, 42., Da Vinci, *The Notebooks of Leonardo Da Vinci*, 126.

<sup>49</sup> Clark, *Leonardo Development as an Artist*, 77.

<sup>50</sup> Laqueur, *Making Sex*.

furthest reaches of the universe as well as the inner universe. As the universe moved inward so did its control over the body. The outer edges controlled the external anatomy of the body while the planets ordered the internal anatomy and the moon influenced the fluids.<sup>51</sup> This economy of fluids, known as the humors, includes black bile, yellow bile, phlegm, and blood. Many physical and psychological illnesses were attributed to an imbalance of these fluids. Bodily humors were also linked to medicine, philosophy, the physical world, and physics through the four elements: Earth (black bile), Water (phlegm), Fire (yellow bile), and Air (blood).<sup>52</sup> By opening up the body to examine its internal fluids, people drew conclusions about the physical world and by basing the balance of these fluids on the physical world people drew conclusions about the health of the body.

Although Leonardo's work closely connected the body and world, he had a different way of relating bodily fluids to the world. He was less concerned with all of the four humors and more interested in the behavior of blood throughout the body. Leonardo believed that the movement of water and movement of blood were intimately connected, as were the veins of the body and the rivers of the world. This analogy helps make sense of Leonardo's in-depth studies of turbulence and the effects of water hitting a wall (figure 7) as they related to how blood moved through the body and how it acted when it hit a valve (figure 8). One of the theories Leonardo used to connect the body to the divine was that the soul resided in the

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<sup>51</sup> Clayton, *The Anatomy of Man*, 15.

<sup>52</sup> Singleton, *Art, Science, and History in the Renaissance*, 241., Kemp, *The Marvelous Works of Nature and Man*, 95.

heart and the veins were a means of connecting the soul to the body.<sup>53</sup> In studying rivers, Leonardo sought to connect the harmony of the world with the harmony of the body.

New methods in empirical science added to the philosophical development of the time. The development of quantitative means of measuring the world with standardized systems resulted in clear outlines for the physical. These systems of measurement excluded qualitative traits from the realm of science and, therefore, other fields absorbed the task of explaining these non-quantifiable systems.<sup>54</sup> This division in the measurement of the world influenced Leonardo's method of research and explanation. He applied his knowledge of representation and perception to explaining the numerically indescribable systems around him. His background as an artist and knowledge of visual perception and representation gave him an advantage in interpreting what it was that he was seeing. In his anatomical sketches he alters what he sees to clarify how the systems work. Instead of drawing overlapping muscles, which would be convoluted and difficult to interpret, Leonardo reduced them down to cords to distinctly show their origin, insertion, and relation to one another (figure 9).<sup>55</sup> He shows an understanding of how others will interpret the visual and how they can process the qualitative.

Just as Renaissance thought was based on classical philosophy, there was also a reemergence of classical style in art, as art was often used as a medium to make the abstract tangible. Many philosophical themes were materialized through

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<sup>53</sup> Da Vinci, *The Notebooks of Leonardo Da Vinci*, 181.

<sup>54</sup> Singleton, *Art, Science, and History in the Renaissance*, 242.

<sup>55</sup> Da Vinci, *The Notebooks of Leonardo Da Vinci*, 105.

art using a combination of classical images as well as new ideas and symbols. Within art, painting in particular underwent a significant change during the Renaissance. Previously considered a mechanical practice, painting was promoted to a liberal art. The 15<sup>th</sup> century humanist author, philosopher, artist, and papal secretary Leon Battista Alberti argued that painting uses investigation and production to convey truths and therefore has the same intellectual rigor as other liberal arts at the time.<sup>56</sup> In humanism, the human experience and education was thought to be a means of elevating the body above the physical to a higher intellect.<sup>57</sup> Along these lines, painting used the physical world, including geometry and mathematics, for perspective, to translate images for the higher mind and intellect.<sup>58</sup> With this promotion from craft to liberal art came a promotion from Reason to Mind. Painting was considered a source for intellect that could bring the artist closer to the divine. The elevation of this skill put pressure on artists to not only depict the divine, but, perhaps more challengingly, to know what the divine even looks like.

A classical idea reemerging in the Renaissance was that there was an ideal human form.<sup>59</sup> This physical ideal has ties to the philosophy of the higher and lower faculties because the ideal body was thought to represent the ideal mind, so more “beautiful” people were admired as being closer to god. Also wrapped up in this concept and depiction of the body is a representation of the world. Analogizing the

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<sup>56</sup> Carroll W. Westfall, “Painting and the Liberal Arts: Alberti’s View,” *Journal of the History of Ideas* 30, no. 4 (1969): 487–506, doi:10.2307/2708607, 494.

<sup>57</sup> Gray, “Renaissance Humanism: The Pursuit of Eloquence”, 504.

<sup>58</sup> Clayton, *The Anatomy of Man*, 13.

<sup>59</sup> C. H. Hallett, “The Origins of the Classical Style in Sculpture,” *The Journal of Hellenic Studies* 106 (1986): 71–84, doi:10.2307/629643, 72.

body to the cosmos had to do with proportions and the belief that harmony within the world was based on fixed ratios that could be represented within the human form.<sup>60</sup> Finding these ideal proportions was attractive for many artists at the time because to represent the body according to them, was to achieve the harmony that governed the worldly and divine. Leonardo, who was already invested in representations of the world inside the body, became very interested in finding the divine proportions of man as an answer to universal questions.<sup>61</sup> Many sketches in his notebooks reflect his search for the canon of ideal beauty and its place between the world and the cosmos, ultimately converging in his sketch of the Vitruvian Man or *L'Uomo Vitruviano*. Based on writings from Vitruvius, the 1<sup>st</sup> century BC Roman architect, Leonardo shows a man inside a circle (the divine) and a square (the worldly) to show the proportions of man (figure 10). Pico della Mirandola articulates the idea that, "Thou shalt have the power to degenerate into the lower forms of life, which are brutish. Though shalt have the power, out of thy soul's judgment, to be reborn into the higher forms, which are divine."<sup>62</sup> The Vitruvian man classically shows that through physical features and divine proportions the individual "chooses" between the divine and lower worlds. Although this drawing contradicts Leonardo's rejection of physiognomy and his emphasis in movement over features, it shows that his art is rooted in the philosophies at the time but by applying Leonardo's theories and methods of study, these classical forms are given new interpretations and meanings. As an artist, his style originated from the

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<sup>60</sup> Clayton, *The Anatomy of Man*, 16.

<sup>61</sup> Da Vinci, *The Notebooks of Leonardo Da Vinci*.

<sup>62</sup> Cassirer, *The Renaissance Philosophy of Man*, 225.



traditions of the time. It was these same traditions that sparked his interest in the body and led him to investigate further into body via anatomy. The knowledge he gained from these studies directly led to Leonardo's distinct views of the body's place in the world.

By connecting the human experience to the divine, art started to draw more from the objective with a scientific emphasis on accuracy. This approach, when applied to representing the body, lead artists to become more interested in the actual structures of the body instead of simply their appearance. The first references to anatomical knowledge of the body for art begin around the 15<sup>th</sup> century with Alberti's treatise *On Painting*.<sup>63</sup> Alberti advises the artist to know the structure of the bones and how they are covered in muscles then skin and flesh.<sup>64</sup>

Although the field of anatomy was of increasing importance in art in the 15<sup>th</sup> century, artists were still not personally performing dissections. Instead, they would go to public dissections at universities to watch demonstrations.<sup>65</sup> The extent of medical knowledge of the body at this time reflected the period when art was not a liberal art and not an important area of study, and as a result, medical books lacked visual diagrams because images were thought to add disorder and clutter to text.<sup>66</sup> As artists were watching dissections, the information that was available was limited visually. In his notebooks Leonardo discusses the process of dissecting and drawing a body accurately. One drawing is a culmination of the dissection of

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<sup>63</sup> Clayton, *The Anatomy of Man*, 11.

<sup>64</sup> Leon Battista Alberti, *Leon Battista Alberti: On Painting: A New Translation and Critical Edition* (Cambridge University Press, 2011), 56.

<sup>65</sup> Clayton, *The Anatomy of Man*, 12.

<sup>66</sup> *Ibid*, 13.

multiple bodies because the structures get obscured by blood or damaged by the dissection.<sup>67</sup> He also comments on the amount of knowledge of anatomy and skill in drawing required to accurately represent the anatomy. The knowledge of the body by artists was usually limited to superficial anatomy to aid in pictorial representation of the body in paintings. The representation artists were looking to achieve was not necessarily a true depiction but, as Mary Garrard in her essay *Leonardo da Vinci: Female Portraits, Female Nature* states, a perfection of what nature provided. Artists were merely concerned with understanding enough of the body's superficial structures to allow them to create a more-than-perfect version of what actually existed. This approach is not in line with Leonardo's interest in the movement and underlying mechanisms of the body. Instead of being interested in the product of nature in relation to perfection, Leonardo devoted his anatomy studies to understanding the processes of nature and how the processes can reveal the divine.

Leonardo's studies on the human form exceed what other artists were interested in. They also go beyond what was necessary to improve his painting making it clear that he was interested in the human form as it functioned in the world. Instead of looking for the divine through representation like other artists of his time, Leonardo integrated art and science and used the human body and how it moved to provide him with answers to the divine body and divine world. The turning point from themes in his early pieces and sketches to his final deluge studies

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<sup>67</sup> Da Vinci, *The Notebooks of Leonardo Da Vinci*, 173.

reveals what Leonardo found amongst the anatomy of the body and its consequence when applied to the greater world.

## Chapter 2. The Body as Nature

Due to the depth and level of detail of Leonardo's dissections, it is clear that his studies went beyond enhancing his art. Leonardo was constantly interested in the world he lived in, especially cause and effect relationships that explained how and why things were happening. The complexity of his study of the body aligns with this idea because he goes beyond the form of the body and shows interest in the mechanisms and interactions within the body. To leave Leonardo's pursuit of the body here would be incomplete. He saw the physical movements of the human form as motions of the soul.<sup>68</sup> These operations of the soul and, by extension, the body are also closely tied to nature throughout Leonardo's studies.

Although this interest may have started through art and representation, Leonardo's anatomy studies gave him a way to express the intentions of the soul. By connecting musculature movements back through nerves, he sought to find where the "soul" resided within the body. His early dissections were based in old theories about the body. These theories affected how he saw the structure of the body in relation to its known function. With these philosophies as his base, Leonardo built up the human body as a parallel to the natural world and believed that the governing principles of the world and the body are interchangeably able to define each other.

Branching off of physiognomy, Leonardo believed that physical movement, not appearance, was suggestive of internal character. This idea, often

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<sup>68</sup> Martain J. Kemp, "Leonardo Da Vinci: Science and the Poetic Impulse," *Journal of the Royal Society of Arts* 133, no. 5343 (1985): 199.

referred to as the theory of *affetti*, is prevalent throughout Leonardo's work.<sup>69</sup> Although in art this theory was heavily applied to facial features and gestures, Leonardo was also interested in what the physical body could tell about the inner body and soul and how the interplay of the soul and body could extend beyond the self to the atmosphere and setting in nature. Many Leonardo da Vinci scholars, such as Martin Clayton and Kenneth Keel, agree that Leonardo believed that actions were to reveal inner character.<sup>70</sup> Movement was to carry out the intention of the soul and to find these intentions Leonardo looked within the body to see how the body moved and where the movements were coming from.

One of the most expressive parts of the body is the face, and as an artist Leonardo was interested in the full range of facial articulations. To an artist, the ability to capture a range of emotions is essential because of how innately perceptive people are to reading facial expressions. In addition to being one of the most developed visual perceptive skills in humans, people look toward faces as the base of social interaction and identity.<sup>71</sup> The ability to empathize and "read" someone is closely tied to how facial features, eyes in particular, act as "windows of the soul". An early pseudo-Aristotelian treatise on physiognomy states, "...that soul and body react on each other; when the character of the soul changes it changes also the form of the body and conversely, when the form of the body changes it changes

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<sup>69</sup> D. Stephen Pepper, "The Ideal of Painting: Pietro Testa's Düsseldorf Notebook," ed. Elizabeth Cropper, *Master Drawings* 26, no. 4 (1988): 363–69.

<sup>70</sup> Martin Clayton, *Leonardo Da Vinci The Divine and the Grotesque* (London: Royal Collection Enterprises Ltd, 2002), Kenneth D. Keele, "Leonardo Da Vinci's Influence on Renaissance Anatomy," *Medical History* 8, no. 4 (October 1, 1964).

<sup>71</sup> James V Haxby, Elizabeth A Hoffman, and M Ida Gobbini, "The Distributed Human Neural System for Face Perception," *Trends in Cognitive Sciences* 4, no. 6 (2000): 223–33.

the character of the soul”.<sup>72</sup> The connection between body and soul was thought to be dynamic and influential as one could mold the other. Faces can express and convey emotion and inner character, making them a powerful tool in understanding and connecting to the world. Because the face is made up of small structures, tiny increments of movement can express such different characters. Leonardo played with these different movements and expressions of the face with his early caricature studies drawn in 1490 (figure 6). These figures have elongated and exaggerated features in a blatant attempt to represent soul and inner character. Ancient theories provide the base concepts for these caricature figures and medical physiognomy, as comprised by Galen, dates all the way back to Hippocrates and Aristotle.<sup>73</sup> Even the theory of affetti is derived from ancient Greek and Roman poetry. Leonardo’s drawings reflect his interpretation of these old ideas that related character to appearance. Leonardo begins his interpretation of these theories with his sketches of caricatures and the effect of the soul on inborn facial structure. As Leonardo continued to explore physiognomy and the implications of the soul’s influence on the physical, he began to alter his understanding of how the soul modifies the body. Instead of the soul altering the face that people are born with, he attributed the effects of facial musculature on the skin to the soul. Clayton asserts that facial features gradually mold to frequent expressions as Leonardo later states, “The face shows some indications of the nature of men, their vices and their

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<sup>72</sup> Michael W. Kwakkelstein, “Leonardo Da Vinci’s Grotesque Heads and the Breaking of the Physiognomic Mould,” *Journal of the Warburg and Courtauld Institutes* 54 (1991): 128, doi:10.2307/751484.

<sup>73</sup> Elizabeth C. Evans, “The Study of Physiognomy in the Second Century A.D.,” *Transactions and Proceedings of the American Philological Association* 72 (1941): 96–108, doi:10.2307/283044.

complexions...show clearly whether these are cheerful men, often laughing; and those who show few such indications are men who engage in thought...".<sup>74</sup>

Beginning with caricatures where Leonardo used inborn features to represent character for example "ugly" feature to show criminal and undesirable character, Leonardo transition to a more mechanical view of the soul's influence. He started to look at how the soul controlled mechanisms of movement, which alter superficial elements of the face.<sup>75</sup>

In order for lines to imprint on the face, a muscle must contract and wrinkle the skin. He has pages in his notebook dedicated to the structures that govern the movements of the face (figure 11). He notes many things including the muscles that compress the mouth vertically and shorten its width, the veins that run through the face, and the size of the nasal cavity and eye sockets in the skull.<sup>76</sup> The nomenclature Leonardo uses to name anatomy is another example of how closely he relates facial movement with emotion and expression. In his "study of the muscles, veins, and nerves of the face, arm, and hand" Leonardo refers to specific muscles as the muscles of anger (*Levator anguli oris* and *Corrugator supercillii*) and muscles of

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<sup>74</sup> Martin Clayton, *Leonardo Da Vinci The Divine and the Grotesque* (London: Royal Collection Enterprises Ltd, 2002), 13.

<sup>75</sup> Martin Clayton, *Leonardo Da Vinci The Divine and the Grotesque* (London: Royal Collection Enterprises Ltd, 2002), 12. Leonardo was interested in beauty and ugliness, which are present in the distorted faces of his caricatures and grotesques. These faces also show Leonardo's attempts at defining beauty through proportionality. Clayton argues that these faces are not related to individual character based on their beauty or ugliness but are part of Leonardo's investigation into physiognomy where he finds that internal character does not relate to facial structure.

<sup>76</sup> Leonardo Da Vinci and Edward MacCurdy, *The Notebooks of Leonardo Da Vinci*, vol. 1 (New York: Reynal & Hitchcock, 1938), 163-6. Martin Clayton, *Leonardo Da Vinci The Anatomy of Man* (Boston: Museum of Fine Arts, 1992), 67.

sorrow (*Temporalis*).<sup>77</sup> On this same page he notes how the movement of the skin and muscles can all be traced back from the nerves to the brain where, as discussed later, he concludes the soul resides (not in the heart). Emotions do not have the ability to control muscles but are instead the expression and result of muscle movement. These movements instead originate in the brain and are actions of the soul. The soul, according to Leonardo, “resides in the seat of the judgment, and the judgment apparently resides in the place where all the sense meet”.<sup>78</sup> It is the connection between the body’s interpretations of the world and how it translates it via cognitive processes into physical movement. The soul is essentially the connection between the physical and mental.

By understanding body movement, Leonardo believed that he could understand the expression of the soul. As Leonardo described the process of his dissections he notes that, “...I shall define the function of the parts in every direction, placing before your eyes the perception of the whole figure and capacity of man in so far as it has local movement by means of its parts. And would that it might please our Creator that I were able to reveal the nature of man and his customs even as I describe his figure!”<sup>79</sup> In other attempts at understanding the world, Leonardo believed that knowing how something functioned and the reason for its existence could help him with a holistic and complete understanding of the phenomena. And

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<sup>77</sup> Martin Clayton and Ron Philo, *Leonardo Da Vinci The Mechanics of Man* (Los Angeles: Royal Collection Enterprises Ltd, 2010), 127. The “muscles for anger” are today referred to as *Levator labii superioris alaeque nasi* and the *Levator labii superioris*, which is the muscles located along the side of the nose and connects down to lift the upper lip, and the *Corrugator supercillii*, located above the brow. The “muscle of sorrow” is the *frontalis*, which is located at the top of the forehead.

<sup>78</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 119.

<sup>79</sup> *Ibid*, 169.



so, in understanding the body Leonardo did a lot of work on different mechanisms of the body and movement of limbs. One example of this is his page on “the superficial anatomy of the shoulder” (figure 12). On this study, Clayton comments that the five views and iterations of shoulder and arm extension form a “rotated series”.<sup>80</sup> These images show that Leonardo is not only interested in the anatomy of the body, but the dynamic interaction of the anatomy in motion. This way of depicting the body allows Leonardo to examine its full range of motion and the effect that these different rotations, positions, and point of views of the joints have on the communicative ability of the body as a whole as opposed to a purely anatomical connections within the isolated joint. Movement goes far beyond limb displacement. As one raises an arm in the socket, the only effect is not simply that the arm raises. Leonardo noted in his treatise *On Painting* that different muscles bulge while their opposing muscles relax, tendons and “cords” show themselves, and the joint, muscles, bones, and fat rearranges itself in a smooth transition.<sup>81</sup> Leonardo comments on these effects when rotating the palm by explaining that, “The arm...will be somewhat shorter when the palm of the hand is turned towards the ground than when it is turned towards the sky...because these two bones...come to intersect in such a way that that which proceeds from the right side of the elbow goes towards the left side of the palm of the hand...The above-mentioned muscles are not firm except at the extremities...the Master [Creator] has done in order that the muscles may be free and ready to be able to grow thicker or shorter or finer or

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<sup>80</sup> Martin Clayton, *Leonardo Da Vinci The Anatomy of Man* (Boston: Museum of Fine Arts, 1992), 95.

<sup>81</sup> Martain Kemp and Margaret Walker, *Leonardo On Painting* (New Haven and London: Yale University Press, 1989), 130, 131.

longer according to the necessity of the thing which they move.”<sup>82</sup> Studying a corpse that he could dissect and see structures below the skin would have given him the knowledge of not only the mechanism, but also the large-scale effects (the length of the arm) and the small-scale effects (the thickness of the muscle fibers). These effects, most significantly the large-scale effects, do contribute to an accurate representation in art but there is no doubt that smaller, more nuanced details of anatomy are part of an interest beyond representations.

“Expression” goes far beyond exaggerated movement. Leonardo uses the concept of expression as the “smooth transitions” where “continuity and the scientific rendering of appearance” come together to create movement.<sup>83</sup> An overcompensation of fictitious anatomy as a means of showing emotion causes the body to “look wooden”.<sup>84</sup> Expressions of the soul come from more than just the shapes and movements of limbs but the small details. Leonardo knew that as one muscle contracts, its antagonist relaxes. When drawn, if the whole body is contracted, it cannot express true emotion because it is not in a natural form. Leonardo used ideas such as these to keep his figures looking natural and true to “the Creator”. As stated earlier Leonardo believed that he could reveal the nature of man through his figure and so the closer Leonardo got to imitating the human figure in its natural and true state the closer he got to understanding and “revealing” the nature and essence of people. Being able to express a “natural” form and figure was

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<sup>82</sup> Leonardo Da Vinci and Edward MacCurdy, *The Notebooks of Leonardo Da Vinci*, vol. 1 (New York: Reynal & Hitchcock, 1938), 103-4.

<sup>83</sup> Kenneth Clark, *Leonardo Da Vinci An Account of His Development as an Artist*, 2nd ed. (Cambridge: Brook Crutchley, University Printer, 1952), xiv.

<sup>84</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 194.

also important to Leonardo because of how high he held nature to be. For him, no being has the ability create better than nature. Leonardo believed that any deviation from a natural form was “superfluous” so knowing true musculature in accordance to nature was the most simple and real form.<sup>85</sup> These muscular expressions that Leonardo understood through dissection lead him closer to understanding the origin of the soul. His version of physiognomy described a strong connection between movement of the body and the soul so the closer he got to describing and imitating the exact movement of the body through anatomy, the better understanding he had of the relationship between the muscles, nerves, brain, and thus, where the soul was located and how it controlled the body in its entirety.

Although Leonardo’s concept of the soul seems intangible and impossible to locate within the body, he did begin to understand more about the actual connection between the brain (where he believed the soul to reside) and musculature via nerve pathways. In his notebook he states, “The function of the nerves is to convey sensation; they are the team of drivers of the soul, for they have their origin from its seat and command the muscles so that they move the members at the consent of the will of this soul.”<sup>86</sup> Leonardo begins with a very abstract notion of the soul as he defines it in terms of its relationship to judgment and the senses but through examination of the body his idea of the soul and its connection to the body becomes more physical and tangible through nerves and muscles and movement.

As Leonardo pursued this idea, and his dissections in general, he was building on previous theories and knowledge of the body. Looking at Leonardo’s

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<sup>85</sup> Ibid, 185.

<sup>86</sup> Ibid, 177.

early anatomy studies can reveal the old theories he was building off of and his baseline knowledge of the human anatomy.<sup>87</sup> His first anatomy studies begin around 1489 with his study of a skull, the cerebral ventricles, and a little later, in 1490, he diagrams the “coition of a hemisected man and woman”.<sup>88</sup> These studies also show where he started with his search for the soul via anatomy.

His initial studies of the cerebral ventricles are shown as three chambers lined up behind the crossing of the optic nerve (figure 13). As Martin Kemp, in *Leonardo da Vinci, the Marvelous Works of Nature and Man*, puts it, these three ventricles in the brain were thought to hold, from front to back, “A. *imprensiva* (receptor of impressions), B. *sensus communis* (coordinator of sensory information), with *fantasia* (imagination), intellect, judgement, etc., and C. *memoria* (memory)”.<sup>89</sup> This is not a new idea but a theory that can be traced for thousands of years from ancient Egyptian mythology to Greek philosophy through western European interpretations of where the soul resides. Two sides of this argument were usually built around the heart (cardiocentric) or brain (cephalocentric) as the location of the soul.<sup>90</sup> The term *sensus communis* was first used by Aristotle to describe the place inside the brain that receives sensory information.<sup>91</sup>

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<sup>87</sup> Charles G. Gross, “Leonardo Da Vinci on the Brain and Eye,” *The Neuroscientist* 3, no. 5 (September 1, 1997): 347–55, doi:10.1177/107385849700300516.

<sup>88</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*, 33,26.

<sup>89</sup> Martin Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man* (Oxford: Oxford University Press, 2006), 109.

<sup>90</sup> Rolando F Del Maestro, “Leonardo Da Vinci and the Search for the Soul” (Lecture, Meeting of the American Osler Society, Baltimore, Maryland, April 27, 2015),

<sup>91</sup> Ibid. Aristotle used this term to describe the intersection of sensory input within the brain but he did not connect this idea with the soul. Aristotle instead believed in the cardiocentric theory of the soul because of the early presence of blood in a chicken embryo.

Leonardo's discussion of nerves is one example of how his search for the soul was built upon these established philosophies. He explains that the *reversive nerve* (known today as the *vagus nerve*, a cranial nerve that controls the heart, lungs, and digestive tract) connects the heart and brain and reasons that if the heart beats on its own the soul resided there because it is the primary agent of the body.<sup>92</sup> If the nerves, which stemmed from the brain, guided the heartbeat then the soul was located in the brain. Leonardo recognizes that the heart does beat on its own but he does not place the soul in the heart because of his conclusion that the heart is just a muscle that heats up cold air brought in from the lungs.<sup>93</sup> This thought experiment shows Leonardo's process of merging his ideas about the body with preexisting ideas about the function of the body. In deciding between the *cardiocentric* and the *cephalocentric* location of the soul, he used the theory as a starting point and interpreted the anatomy in either support or refutation of these theories.<sup>94</sup>

The supposed function of the body informs the structures that he was discovering. In looking at its structure, Leonardo concludes that the connectivity of the optic nerve to the *senso commune* is proof that the soul resides in the brain.<sup>95</sup> If all the senses did not meet in the soul, but were instead pervasive throughout the entire body then the optic nerve need not exist and the surface of the eye should be sufficient for visual perception of the world. To Leonardo, the fact that the sensory

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<sup>92</sup> Gross, "Leonardo Da Vinci on the Brain and Eye.", MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 181.

<sup>93</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 181.

<sup>94</sup> Del Maestro, "Leonardo Da Vinci and the Search for the Soul."

<sup>95</sup> Jean Paul Richter and Leonardo Da Vinci, *The Notebooks of Leonardo Da Vinci*, vol. 2, 2 vols. (New York: Dover Publication, 1907), 127.

visual input is connected to the brain shows that the soul is on the other end of the optic nerve to interpret these senses.

The majority of Leonardo's writing about the soul was that it was located in the brain in the "senso commune".<sup>96</sup> This conclusion is not all that surprising when taking into account that he believed that the senso commune was the ventricle in the brain where the senses converged. During his lifetime, Leonardo displayed a cumulative focus on materiality and physicality, especially within the natural world, and so it makes sense that Leonardo saw the soul to be where the body communicated and took in the physical world. His descriptions of the proportions of the skull in his notebook include, "Where the line  $a m$  intersects the line  $c b$  there will be the meeting place of all the senses; and where the line  $r n$  intersects the line  $h f$  there will be the axis of the cranium in the third of the divisions of the head" (figure 14).<sup>97</sup> Leonardo's discovery of the senso commune within the skull comes from many interpretations of this senso commune theory. Aside from Aristotle, Leonardo was familiar with Avicenna, Albertus Magnus, Roger Bacon, and Mundinus, who all wrote about the convergence of the senses.<sup>98</sup> According to the Italian Baroque art historian Dr. Stephen Pepper, Leonardo used the theory of affetti to connect the senso commune to physical expression. Emotion and articulation of the body are expressions of the soul from within the senso commune. Pepper argues that the body takes in outside information from the senses and the soul interprets these

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<sup>96</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*.

<sup>97</sup> *Ibid*, 163.

<sup>98</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 108.

signals as a way of “representing the physical world”.<sup>99</sup> His sketches and proportioning of the brain are grounded in theoretical reasoning about the soul, rather than simply on “anatomy”. What seems like a pursuit of science seems to hint at looking towards another “creator” for answers about the body and soul. For these answers Leonardo looked deeper and deeper into the physicality of the body but ends up reasoning through explanations in regards to the soul’s relationship with nature.

Leonardo’s drawing of *Coition of a Hemisected Man and Woman* (figure 15) is another illustration of an old theory that Leonardo confirms anatomically through hindsight. Drawn in 1490, this is one of Leonardo’s early attempts to illustrate what he believed the body to be before he performed any real dissections himself.<sup>100</sup> In his book *Making Sex: Body and Gender from the Greeks to Freud*, Thomas Laqueur describes the *economy of fluid* where people believed the humors of the body to be interconnected.<sup>101</sup> In this study, Leonardo argues that semen originated from the spinal cord, which connects to the brain. The brain was believed to, quite literally, give life. These ventricles in the brain were believed to be filled with a fluid that connected the senses and the soul to the spinal cord, which then stretched down the body and had branches to the rest of the body.<sup>102</sup> Kenneth Keele’s translation of the writing on the sketch shows Leonardo’s references to the first century A.D. Islamic medical philosopher, Avicenna. Avicenna believed that “the most active and thickest

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<sup>99</sup> Pepper, “The Ideal of Painting: Pietro Testa’s Düsseldorf Notebook.”

<sup>100</sup> Clayton and Philo, *Leonardo Da Vinci The Mechanics of Man*, 11.

<sup>101</sup> Thomas Laqueur, *Making Sex: Body and Gender from the Greeks to Freud* (Cambridge: Harvard University Press, 1990).

<sup>102</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*, 74.

part of the semen, carrying the animal spirit or soul to the future embryo, comes from the spinal cord.”<sup>103</sup> Leonardo used this theory as a basis for human anatomy but not actual dissections themselves. Leonardo drew a semen duct leading from the spinal cord to the penis even though he had not dissected enough of the body to confirm this. His reliance and hurriedness to affirm old theories outweighs emphasis on accuracy in the body’s real structure and function.

Leonardo used Avicenna’s idea that the animal spirit runs through the spinal cord and applied it to the whole body. He believed that a network of cords ran from the spine to the muscles and carried this animal spirit and soul from the ventricles to the sheaths of the muscles to “command movement”.<sup>104</sup> Working as a two way street, these cords could also take senses from the outside world to the *senso commune*.

The theory of the *senso commune* appealed to Leonardo not just because he believed he could prove it through anatomy. Having the soul reside where the senses converged allowed Leonardo to trace the soul via material interactions with the physical world, and thus a connection between the soul and what Leonardo considered to be the “Master”. Leonardo referred to nature as the “Creator” and “Master”.<sup>105</sup> The physical and worldly were usually seen as inferior but Leonardo holds nature and natural beings to be the highest creator.<sup>106</sup> He writes that it is impossible to “devise an invention more beautiful more simple or more direct than

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<sup>103</sup> Leonardo da Vinci, Kenneth David Keele, and Jane Roberts, *Leonardo Da Vinci: Anatomical Drawings from the Royal Library, Windsor Castle* (Metropolitan Museum of Art, 1983).

<sup>104</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 118-9.

<sup>105</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*.

<sup>106</sup> Erwin Panofsky, *Studies in Iconology: The Humanistic Themes In the Art of the Renaissance* (New York: Oxford University Press, 1939).



does nature, because in her inventions nothing is lack, and nothing is superfluous; and she needs no countervailing weights when she creates limbs fitting for movement in the bodies of the animal, but puts within them the soul of the body”.<sup>107</sup> Here he defines the highest creator as Nature, whose creations need no modification or enhancement. He also credits Nature with the formation of a creature’s soul. This new “divinity” is based upon the physical world and connects materiality with creation. The soul not only was able to communicate with the physical world (a parallel to the physical body) through the senses, but Leonardo also believed that the purpose of the soul was to understand the physical world.<sup>108</sup>

Another means of connecting the body to the world was the microcosm/macrocosm theory. The ventricle that contained the *senso commune* was connected to the spinal cord and therefore the rest of the body, especially the blood. The senses could take in the world and distribute it around the body. Leonardo was very interested in the movement of blood through and around the body because he believed it to be analogous to the water of the world. He states in his notebook, “That cause which moves the water through its springs against the natural course of gravity is like that which moves the humors in all the shapes of animated bodies.”<sup>109</sup> Through the connections of the humors within the body, from the ventricles to the spinal cord to the blood, and the connection of the blood to the rivers of the world, Leonardo drew a blueprint of the world with all of its creatures’ souls flowing through it.

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<sup>107</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 185.

<sup>108</sup> *Ibid*, 110.

<sup>109</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*.

Leonardo did not just believe that nature was similar to the human body in physical form but he also believed that the same laws governed them. With these two structures (the body and the world) operating under the same rules, he used the microcosm theory as a starting point to explain physical aspects of the body such as how the blood flowed through the veins or how the body heated incoming air. His dissections confirmed these theories because he was mentally molding his findings to adhere with these governing philosophies. This theory was the basis for how Leonardo envisioned the movement of fluids of the body, the structures that supported the body, and the world.<sup>110</sup> Leonardo summarizes the physical embodiment of the world:

“...man is composed of water, earth, air, and fire, his body is an analogue for the world: just as man has in himself bones, the supports and armature of his flesh, the world has the rocks; just as man has in himself the lake of blood, in which the lungs increase and decrease during breathing, so the body of the earth has its oceanic seas which likewise increase and decrease every six hours with the breathing of the world; just as in that lake of blood the veins originate, which make ramifications throughout the human body, similarly the oceanic sea fills the body of the earth with infinite veins of water. The nerves are lacking in the body of the earth. The nerves are not to be seen there because the nerves are made for the purpose of movement, and the world being perpetually stable, movement does not occur, and movement not happening, the nerves are not necessary there. But in all other things they are very similar.”<sup>111</sup>

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<sup>110</sup> Martain J. Kemp, “Leonardo Da Vinci: Science and the Poetic Impulse,” *Journal of the Royal Society of Arts* 133, no. 5343 (1985): 209.

<sup>111</sup> Quoted from: Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 98-99.

These general assumptions of how the body and world worked break down into more specific theories. Leonardo explains the branching architecture between trees and rivers (figure 16). He states, “All branches of a tree at every stage of its height when put together are equal in thickness to the trunk [below them]. All the branches of a water [course], if they are of equal rapidity, are equal to the body of the main stream.”<sup>112</sup> This theory, still used today in biological conservation to predict the biomass of trees, stemmed from his work with the cardiovascular system in the human body.<sup>113</sup> He first established that the branching of arteries in the body diminished in size until they became arterioles (the smallest arteries not easily visible to the naked eye).<sup>114</sup> Because of the micro/macro theory, Leonardo applied this model to the natural world within systems that seemed to resemble arterial branching and fluid bifurcation (trees and rivers).

As the human body revealed more and more of itself to Leonardo, he felt as though he could understand the world better. The connection of the soul and physical body to nature gave an intimate understanding of the processes of the world. Based on these governing principles of the world, Leonardo attempted to perfect and expand on nature’s creations. Leonardo tried to expand the natural ability of the human body by giving it the power of flight. Because he understood the principles that allowed birds to fly, Leonardo built machines to allow people to

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<sup>112</sup> Jean Paul Richter and Leonardo Da Vinci, *The Notebooks of Leonardo Da Vinci*, vol. 1, 2 vols. (New York: Dover Publication, 1907), 205.

<sup>113</sup> Andrew D. Richardson and Heinrich zu Dohna, “Predicting Root Biomass from Branching Patterns of Douglas-Fir Root Systems,” *Oikos* 100, no. 1 (2003): 96–104, M. Gharib et al., “Leonardo’s Vision of Flow Visualization,” *Experiments in Fluids* 33, no. 1 (July 1, 2002): 219–23.

<sup>114</sup> M. Gharib et al., “Leonardo’s Vision of Flow Visualization,” *Experiments in Fluids* 33, no. 1 (July 1, 2002): 219–23.

fly.<sup>115</sup> If the body did indeed have the physical capacities that the world did then it should have been able to take on the same principles as nature but because it was not originally given these qualities inherently, Leonardo sought to go above the natural rules in trying to make a more complex organism. Leonardo considered nature to be the highest creator because it made the most pure and simple creatures and so adding complexities was to go break these natural laws that Leonardo held so high.

Leonardo's nickname as the "father of modern science" makes it seem like he completely threw away old theories and utilized original methods and ideas to understand the world. While he was a revolutionary thinker, his ideas were deeply rooted in models from ancient times. His initial interest and research of anatomy was concentrated from 1487 to 1495. During this time he, like other artists of his time, had seen dissections performed at a medical school but had no hands-on experience with the human anatomy and so his sketches from this period rely heavily on old theories. Although Leonardo accepted these theories he used them as a base but thought of them with different contexts. Always interested in the physical, Leonardo interpreted these pre-existing ideas of the soul and body within the material natural world. Leonardo's dynamic way of thinking about the body within the physical world allowed him to develop empirical ideas and processes.

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<sup>115</sup> Raffaele Giacomelli, "The Aerodynamics of Leonardo Da Vinci," *Journal of the Royal Aeronautical Society* 34, no. 240 (1930): 1016–38.

### Chapter 3. The Body as Part of Nature

Leonardo's anatomy studies can be broken into different stages during his life. Martin Clayton, in his book *Leonardo da Vinci, The Anatomy of Man*, groups his anatomical studies into three blocks: 1487-1495, 1504-1509, and 1510-1513.<sup>116</sup> During the first period of study Leonardo was part of the Sforza court in Milan with various responsibilities per his varying skill set.<sup>117</sup> From 1487 to 1495 Leonardo's interest in the body intensifies into actual sketches of anatomy. At this time it is thought that he had a skull but had not yet had the experience of personally dissecting bodies, although he had at this point witnessed dissections at medical school as was common for artists of his time.<sup>118</sup> The sketches that he drew from this first period of dissections are reflections of what he did know about the body through information already accepted in the world. From looking at these drawings and reading his notebooks, it is clear that his main focuses, namely physiognomy, the *senso commune*, and the microcosm stem from old theories about the body.<sup>119</sup>

His second period of anatomy studies occurred at a time when he was moving back and forth between Florence and Milan. While in Florence in 1503 he lived in the hospital of Santa Maria Nuova.<sup>120</sup> This gave him the opportunity to

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<sup>116</sup> Martin Clayton, *Leonardo Da Vinci The Anatomy of Man* (Boston: Museum of Fine Arts, 1992). Although Clayton's second block of time begins with 1504, he states that this was characterized by nude sketches for the *Battle of Anghiari* but not dissections on bodies. Leonardo got back into dissection with the centenarian in 1507.

<sup>117</sup> Kenneth Clark, *Leonardo Da Vinci An Account of His Development as an Artist*, 2nd ed. (Cambridge: Brook Crutchley, University Printer, 1952), 181.

<sup>118</sup> Martin Clayton and Ron Philo, *Leonardo Da Vinci The Mechanics of Man* (Los Angeles: Royal Collection Enterprises Ltd, 2010), 12.

<sup>119</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*, 15.

<sup>120</sup> *Ibid*, 130.

dissect his first human body, the centenarian.<sup>121</sup> His work produced from this dissection focused a lot on internal bodily functions such as the cardiovascular system, the liver, spleen, and other sub-diaphragmatic organs.<sup>122</sup> During his study of this body, he was still interested in the concept of the soul but he became more interested in not only the mechanics of the body but also the mechanics of death.<sup>123</sup> Leonardo determined the cause of death to be from “failure of blood and of the artery that feeds the heart and the lower members...” and from thickening of the veins and restriction of blood flow.<sup>124</sup> The failure of blood flow prompted his work with hydraulics and hydrostatics because the blood within the body should work like the waters in rivers according to the micro/macro theory.<sup>125</sup> During this time frame, Leonardo went back to Milan twice where one of his projects for the Sforza court was canalization.<sup>126</sup> These studies of water and its implications within the body in the form of blood as it bifurcates and pulses increase Leonardo’s interest in how natural forces that can be observed in the world act within the body.

His third and final block of anatomical studies (1510-1513) is distinguishable because of its unique synthesis of the body. In contrast to Leonardo’s initial understanding of the body where function informed form, his late approach is very

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<sup>121</sup> Edward MacCurdy and Leonardo Da Vinci, *The Notebooks of Leonardo Da Vinci*, vol. 1 (New York: Reynal & Hitchcock, 1938), 125. Clayton and Philo, *Leonardo Da Vinci The Mechanics of Man*, 18. In the hospital of Santa Maria Nuova in Florence during the winter of 1507-8, Leonardo had the chance to dissect an old man. Leonardo reports that right before the man died, he told him that he “had lived a hundred years” and so he is often referred to as the *centenarian* or *il uechio*.

<sup>122</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*.

<sup>123</sup> Martin Kemp, “Dissection and Divinity in Leonardo’s Late Anatomies,” *Journal of the Warburg and Courtauld Institutes* 35 (1972): 200–225, doi:10.2307/750929.

<sup>124</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 125.

<sup>125</sup> Eugen Oberhammer, “Leonardo Da Vinci and the Art of the Renaissance in Its Relations to Geography,” *The Geographical Journal* 33, no. 5 (1909): 540–69.

<sup>126</sup> Clark, *Leonardo Da Vinci An Account of His Development as an Artist*, 131.

different, even contradictory to his first. Clayton concludes that material observation takes over assumed structure and function as he reaches conclusions through pure empiricism.<sup>127</sup> During this time he focused a lot on the musculoskeletal mechanisms such as the spinal column, structures of the shoulder, and muscles of the arm, and, in 1512-13, his final studies focus on the heart.<sup>128</sup>

This change, although noticeable in his anatomy studies, was probably influenced by a range of factors before and within this period. One area of study that Clayton, in his book *Leonardo da Vinci, the Mechanics of Man*, notes is Leonardo's work on horses.<sup>129</sup> In 1482 Leonardo traveled to Milan to undertake a commission by Ludovico Sforza to design a bronze equestrian monument for Ludovico's late father.<sup>130</sup> The casting of this incredible monument required extensive research and preparatory drawings on horses and to draw these horses Leonardo used models of horses from his patron's stables in Milan. In Leonardo's notes he speaks in terms that allude to different breeds of horses.<sup>131</sup> Each breed of horse had different proportions, but because of the vast variation in breeds, none had proportions that were superior as there was no one ideal body of a horse. Leonardo was not specifically looking to confirm a preconceived truth or divinity within the horse bodies he was looking at and he began to rely more heavily on

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<sup>127</sup> Clayton and Philo, *Leonardo Da Vinci The Mechanics of Man*, 20.

<sup>128</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*.

<sup>129</sup> Clayton and Philo, *Leonardo Da Vinci The Mechanics of Man*, 16.

<sup>130</sup> Kenneth Clark, *Leonardo Da Vinci An Account of His Development as an Artist*, 2nd ed. (Cambridge: Brook Crutchley, University Printer, 1952)85, 181.

<sup>131</sup> Martin Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man* (Oxford: Oxford University Press, 2006), 193. Leonard speaks of different breeds such as a "Sciliano", an Italian cavalry breed, and a "Genet", a Spanish horse also referred to as a Jennet. Leonardo measured these horses to record their complex proportions showing that different breeds of horses could not have one accepted standard of proportion.

observation. All of the forms he was looking at were important in his studies for the monument and lack of a proportional ideal meant that Leonardo could not overlook structures to affirm a model body.<sup>132</sup>

In 1499 the French invaded Milan and Ludovico Sforza was overthrown so Leonardo returned to Florence without ever creating his equestrian monument. After spending a little time painting, traveling, and working as a military engineer, Leonardo looked once again at the human body.<sup>133</sup> While resuming focus on the body, Leonardo also took a commission in 1503 from the Grand Council Chamber of the Palazzo Signoria for the *Battle of Anghiari*.<sup>134</sup> This fresco remains only in preparatory drawings where the subjects are horses and men in dynamic action. The variation in proportions of horse bodies that Leonardo researched for the Sforza monument gave way to free movement and wild expressions for the battle. The lack of control within the movements of both the horse and riders is far from the controlled cannon of the body that Leonardo previously relied on. Once again throwing out any sense of “ideal” in the controlled proportions of the figure, Leonardo was able to capture the charging, rearing, and wild horses through observation. Clayton notes this style change as “liberating” for Leonardo to be free from static and predetermined molds of horses and humans (figure 17).

This relationship between horses and humans also shows how Leonardo used comparative anatomy, a technique Leonardo frequently employed that compared other species’ anatomies with that of humans. This allowed Leonardo to

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<sup>132</sup> Clayton and Philo, *Leonardo Da Vinci The Mechanics of Man*, 16.

<sup>133</sup> *Ibid*, 16.

<sup>134</sup> *Ibid*, 16.



transfer his new empirical approach towards horses to the human body. In his drawing of the anatomy of the back leg of a horse and the leg of a man, Leonardo compares macro structures as well as details (figure 18).<sup>135</sup> The movement of a human body as it propels forward is strikingly similar to the structure of a horse's leg. The hoof of a horse seemingly resembles the foot of a person but Leonardo noted how as a person rises up on the toes, the heel matches the hock (a joint in the rear leg) of the horse's leg. This positioning creates synchronized joints between human legs and horse legs. The use of comparative anatomy to understand the human form gave Leonardo a way to apply the originality of his observations of horses to people. Hundreds of years before modern evolution theories, Leonardo connected the anatomy of different animals to humans. Diverging from traditional theories of creation from divine being, Leonardo, although not directly, started leaning towards other forms of creation by looking at homologous structures.

The influence of Leonardo's horse studies is evident in other sketches. His anatomy of the face references his previous studies of horse musculature and can even be connected, for instance, with specific sketches for the *Battle of Anghiari*.<sup>136</sup> Clayton's translation of this folio shows that Leonardo wrote, "Observe whether the muscles which raises the nares [nostrils] of the horse is the same as that which lies in here at *f*".<sup>137</sup> The wording of this note even shows the transition from theory to empiricism. Here he begins with an observation to understand the structure. Only

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<sup>135</sup> K. D. Keele, "Leonardo Da Vinci's 'Anatomia Naturale'. The Inaugural John F. Fulton Lecture. Yale University School of Medicine November 3, 1978.," *The Yale Journal of Biology and Medicine* 52, no. 4 (1979): 397.

<sup>136</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*, 110.

<sup>137</sup> *Ibid*, 110.

through understanding the origin and insertion of the muscles and how it is composed within the face can he understand the function. Instead of relying on previous models of the face or even modeling the face after a horse, Leonardo uses observation to understand more about the body. Clayton assesses Leonardo's work after this reformulation by stating, "the accuracy of his drawing was no longer compromised by the limits of his understanding".<sup>138</sup> Instead of interpreting parts of the body in terms of how it fit previous knowledge, Leonardo began to use his skills of observation and representation to understand the structure of the body. From this empirically derived structure he could then propose mechanisms and functions for them.

After 1508 Leonardo's studies focus on the mechanics of skeletal movement and he became obsessed with carefully understanding every motion, structure, and layer of the body. His ultimate goal was to put together an anatomical treatise, most of which is lost. It is not known how close he was to finishing the treatise but he references the "120 chapters" he had completed and was still far from his goal. Vasari stated that Leonardo was not able to finish the manuscript because his "profound and discerning mind was so ambitious that this was itself an impediment; and the reason he failed was that he endeavored to add excellence to excellence and perfection to perfection."<sup>139</sup>

As he worked toward understanding the smallest structures of the body, Leonardo began to explore elements that were previously unstudied. One example of this is his page on "the motor muscles of the lips of the mouth" (figure 19).

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<sup>138</sup> Ibid, 19.

<sup>139</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*, 22.

Clayton mentions that there is a lack of tradition to “distract” Leonardo’s study.<sup>140</sup> With no preconceived ideas about the lips and mouth within the larger body, or for that matter, the greater world, Leonardo had no foundation from which to build his work. He had to lay his own groundwork rooted in observation and empiricism to study this structure of the body.

With the work he had ahead of him in undertaking this ambitious treatise, Leonardo forged a friendship with the professional anatomist, Marcantonio della Torre.<sup>141</sup> These two worked together to integrate the teachings of the Greek natural philosopher and founder of medicine, Galen with anatomy, and medical science.<sup>142</sup> With this shift towards Galenism, Leonardo’s understanding of the human body moved from philosophical to functional. Leonardo’s greatest take away from Galen was that every part of the body had a purpose.<sup>143</sup> Because every part of the body was necessary, Leonardo did not need to start his study with of why it was there but through his process of observing and recording a phenomenon, he would understand why it existed in terms of its function. Before this, Leonardo’s work was limited by his prior knowledge and his errors were based in speculation, but now, as his precision grew, so did his knowledge creating a cycle of discovery, experience, and confidence in observation.

Throughout the last two periods of his anatomy studies from 1504 onward, as his perception of the body changed, so did his representation of it. Leonardo ran

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<sup>140</sup> Ibid, 66.

<sup>141</sup> Kenneth D. Keele, “Leonardo Da Vinci’s Influence on Renaissance Anatomy,” *Medical History* 8, no. 4 (October 1, 1964): 361.

<sup>142</sup> Ibid, 369.

<sup>143</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*, 20.

into many problems while trying to depict what he saw. As an artist, he clearly understood how people perceived images and he used his knowledge of perception to represent the body in new ways. His notebooks reveal how he thought through these different problems. One of his sketches is the result of more than ten dissections because of how the body becomes obscured from the “bleeding of the capillary veins” and the damage done to the structures with the dissections itself.<sup>144</sup> Leonardo states “those sciences are vain and full of error which are not born of experience, mother of all certainty, first-hand experience which in its origins, or means of end has passed through on of the five senses...” but he also recognizes the difficulty in learning anatomy from a corpse so his drawings were made to capture more than one angle and perspective.<sup>145</sup> Not just visually accurate, they have to be able to give a sense of spatial relations inside the tight area of the body.

While most of his notes on the musculoskeletal system discuss drawing the bones then clothing them by degrees with membranes, muscles, fat, then skin, some of them talk about the space within the body.<sup>146</sup> Because the body was made with nothing in excess there is no extra space. For the sake of the viewer, Leonardo’s studies were not always exactly representative of the human body. He writes, “You will show first the bones separated and somewhat out of position, so that it may be possible to distinguish better the shape of each piece of bone by itself”.<sup>147</sup> Leonardo ensured that this was not misrepresentative of the body by labeling the size and spacing of each bone. Because each of his discoveries were based in observing the

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<sup>144</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 173.

<sup>145</sup> Ibid, 84.

<sup>146</sup> Ibid, 108-9.

<sup>147</sup> Ibid, 117.

form of each system in the body, it was crucial for his sketches to represent what was evident from a 3D form on a 2D surface.

Another approach to representing the body was what scholars now call his “exploded view” (figure 20).<sup>148</sup> Clayton characterizes this approach as “depicting the elements pulled apart to show their articular surfaces and how they connect.”<sup>149</sup> How these elements became complex movements all relied on the interactions of their surfaces to create greater mechanisms, so the way in which Leonardo drew the joints gives insight into how he thought about them. By looking individually at the basic elements that worked together to create the multifaceted functions of the body, Leonardo created a “new space” for the body to exist in. Within this space there was a greater emphasis on the connection between structure and function of the body. The most common function of the musculoskeletal system is movement and to best understand how each muscle affected individual bones Leonardo would pull on the tendons to know their origin.<sup>150</sup> He would then draw these tendons, muscles, and ligaments as cords. He notes in his transcripts, “and to these movements should be assigned the cords and muscles which are the cause of these movements, and consequently, if a man should be found lacking in power to make one of these movements as a result of some wound, one can discern which certainty which cord or muscle is impeded.”<sup>151</sup> This made it easier to visualize which muscles passed over and under each other and their place of origin and insertion. Each

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<sup>148</sup> Clayton and Philo, *Leonardo Da Vinci The Mechanics of Man*, 24. Kemp, “Dissection and Divinity in Leonardo’s Late Anatomies”, 208.

<sup>149</sup> Clayton and Philo, *Leonardo Da Vinci The Mechanics of Man*, 24.

<sup>150</sup> Kemp, “Dissection and Divinity in Leonardo’s Late Anatomies”, 208.

<sup>151</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 105.

movement is characterized by what mechanism is involved. Their actual structure was condensed down to how they functioned. The simplification of the body also shows Leonardo's increasing understanding of the complexity of the body.

To accurately represent all the intricacies of the body, some structures had to be simplified in their representation. Martin Kemp looks at the connection between text and drawing in his later dissections to show their unique interaction as a result of his shift to empiricism.<sup>152</sup> Looking once again at his theory on branching in trees and rivers, Leonardo used mathematical formulas govern the structures within the human body. In his drawing of respiratory organs (figure 21), it is clear that the tracheal bifurcation follows a rigid pattern. This study dates to 1508, when Leonardo was in his second period of anatomy work. At this point in his life Leonardo is 56 years old, 11 years before his death, yet his studies continue to shift in response to his more discoveries. Comparing his study of the branching of the respiratory system in 1508 to his notes on the muscles of the arm and the superficial vessels in 1510-11, (figure 22) there is a definite change in the representation of channels. The vessels in his later sketch are less rigidly cut and have a more organic feeling to them (refer to figures 21 and 22 for comparison). Although their style changes, they still adhere to the governing laws that Leonardo originally based his work on. While Leonardo's interpretations of the body appear more organic in these drawings, Kemp notes that his writings become more reliant on mathematics. This interplay between a natural representation and a

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<sup>152</sup> Kemp, "Dissection and Divinity in Leonardo's Late Anatomies", 216.

mathematical description shows the tension between models as Leonardo applied laws of the world to the body.

The fluid dynamics of the body gave way to fluid dynamics in the natural world, for example hydraulics, water velocities, the disturbance and swirl of water as it hits a wall, and irrigation. The intersection between studying the heart valves and vessels and studying hydrostatics is a distinct point where Leonardo had difficulty relating his mathematical models to natural systems. In *Leonardo da Vinci the Marvelous Works of Nature and Man*, Kemp describes Leonardo's "marriage of organic complexity and mathematical certainty in the context of mechanical law" as "far from straightforward".<sup>153</sup> What started as an encompassing theory to explain the cross-sectional areas of branches turned into a complex study to understand water and how it moved. The more Leonardo studied hydraulics, the more he understood the power and unpredictability of water. His mathematical understanding of the dynamic properties of water proves to be inadequate to describe water as it behaved within the world and inside the body. He reports that the movement of objects placed at the intersection of streams is "sometimes swift, sometimes slow, and sometimes turning to the right and sometimes to the left, at one instant upwards and at another downwards, turning over and back on itself, now in one direction and now in motion..."<sup>154</sup> Instead of getting closer to a unified theory to describe the behavior of water, Leonardo's studies instead exposed the power and volatile nature of water.

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<sup>153</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 297.

<sup>154</sup> *Ibid*, 304.

Another possible reason as to why Leonardo's theory on the bifurcation of water did not transfer from the body to the natural world and vice versa is that the circulatory and respiratory system are closed systems in which evaporation does not occur. His theory hinges on the premise that there is a constant volume and pressure within the branches but evaporation and the reduced friction from the open structure of rivers changes the volume and speed of the system and therefore does not adhere to conditions that would make this theory true.<sup>155</sup> The more Leonardo investigated hydraulics in conjunction with anatomy, the further apart the human body and the natural world seemed.

Water and blood were what connected the human body to the physical world. The rivers of the world ran through the veins of the body while the water that poured from the mountains was the bleeding of the earth. The physical laws that Leonardo used to connect the body to nature began to do the opposite and instead further divide them. Kemp compiles other observations of Leonardo's that weakened this analogy between the human body and nature, for example the sea cannot be analogous to the blood in the heart because the heart is the source of the blood in the body while the sea is the sink to the water of the mountains.<sup>156</sup> As a result, Leonardo had to accept that the same laws that governed the terrestrial world did not govern the human body. This altered the analogous thinking of the human in relation to the world. Kemp argues that instead of placing the world inside the human body Leonardo had to acknowledge the human body as occupying

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<sup>155</sup> Kemp, Martin, *Seen/Unseen: Art, Science, and Intuition from Leonardo to the Hubble Telescope*, Oxford, 2006, 91-92.

<sup>156</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 313.



a place inside the world. The human was a piece of nature, not a representation of it and Leonardo goes on to say, “...we cannot place ourselves outside or above nature...”.<sup>157</sup> People cease to represent or have power over nature, but instead become one aspect in the whole of the world. With people now part of the world, the properties of nature that Leonardo was trying to find *within* the body could now be considered as free to act *upon* the body and so people become dependent and vulnerable to the world.

Leonardo believed one of the strongest ties the body had to the world was through water. He was so captivated by its power that his notebooks contain over “seven hundred and thirty conclusions” about water.<sup>158</sup> His dissections, however, showed a deepening contrast between the function of blood and the natural power of water. The power of the human body was limited by the intricate anatomy that allowed it to perform just the task that it needed to. Nature is simple and as Leonardo states, “...in her inventions nothing is lacking, and nothing is superfluous.”<sup>159</sup> The human body was built with straightforward mechanics. It was not made to withstand or represent the power of water in any literal or figurative way. Although the power of water interested Leonardo, it was the power of water over the body and, as Kenneth Clark states, “...the power of water beyond human control”, that washed away the micro/macrocosm theory.<sup>160</sup>

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<sup>157</sup> Kemp, Martin, *Seen/Unseen: Art, Science, and Intuition from Leonardo to the Hubble Telescope*, 92

<sup>158</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 305.

<sup>159</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 185.

<sup>160</sup> Clark, *Leonardo Da Vinci An Account of His Development as an Artist*, 180.

With the blood disconnected from the water of the world the soul became disconnected as well from the literal fluids of the world. In understanding the body, Leonardo believed that he was able to grasp how the world works. As he began to recognize the split between the physics of the body and the physics of nature, many basic questions about the earth were thrown back into the dark. The physical world is what drove the soul. The *senso commune* took in information and, according to Leonardo, the truth and the greatest purpose of the soul was to understand the entirety of the world.<sup>161</sup> Although he pioneered so many fields in the study of the world, it was mostly built on the premise of the world being analogous to the body. Leonardo was no longer able to understand the world through the body, which threw his knowledge into uncertainty. The increase in empiricism that was directed toward the human body did lead to this doubt in understanding the world but it also provided new empirical methods of understanding the world. Although not able to understand the whole of the world and all the forces at play, Leonardo still had the capability of understanding and explaining what he saw.

Leonardo's reliance on empiricism and the certainty in material evidence drove him to look at the body in terms of its form and then function. Knowledge of the physical form was necessary before understanding or even speculating the purpose of the system. In 1508 Leonardo looked once again at the ventricles in the brain. Instead of speculating about their form, he injected wax into an ox brain to make a cast of the ventricles (figure 23). Although he maintained his stance on the *senso commune*, he used these real ventricles of the brain as the basis for the theory

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<sup>161</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 110.

and did not alter the structure in affirmation of that theory (compare figure 13 and figure 23).<sup>162</sup> Later on, while looking back at the body and soul with a new comprehension of the connections, or lack thereof, with the world, he states, “the rest of the definition of the soul ... I leave to the consideration of the friars, the fathers of the people, who by inspiration know all the mysteries”.<sup>163</sup> Leonardo’s delineation of the limits of empirical knowledge extends to the seat of the soul itself. He still believed that people had a soul but much of its function he began to ignore because it wasn’t comprehensible through physical evidence. Just as before, he could try to understand people’s actions as an expression of their soul but did this give him insight to the physicality and location of the soul? His botany, hydrodynamic, and other studies of the physical world and its governing laws could help him understand some expressions of the natural world but do they in themselves hold the answer as to the physical world and whether Nature was the supreme creator? Knowledge of the body was not analogous to knowledge of the world but also in question was whether knowledge about aspects and secondary characteristics of an entity could give insight to its essence and primary being.

The dynamic world was no longer connected to the body but disconnected and independent for study. Through his knowledge and understanding of physical forces, Leonardo tried to harness and exploit many of these principles for human control. He tried to use winds and air to give humans flight, hydraulics and currents to reroute and bend rivers, and material density and buoyancy to breath

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<sup>162</sup> Clayton, *Leonardo Da Vinci The Anatomy of Man*, 76.

<sup>163</sup> Kemp, “Dissection and Divinity in Leonardo’s Late Anatomies”, 212.

underwater with no avail.<sup>164</sup> The body and the world could work together because they were one but after severing this connection, people became subject to, and not in control of, the disorder and strength of the world.

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<sup>164</sup> Robert H. Davis, "Deep Diving and Under-Water Rescue. I," *Journal of the Royal Society of Arts* 82, no. 4266 (1934): 1032–47. Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*.

## Chapter 4. Representations of the Body in Leonardo's Art

Leonardo's investigation on the inside of the body effected how he portrayed the outside of the body within his art. Because of this his art reflects his dynamic shift from old theories about the body to a new relationship between it and its environment. Although Leonardo's anatomical studies are complete and refined drawings that certainly draw upon his artistic knowledge, it is worth looking at the body within his pieces that are considered more classical art. These pieces not only tell more of a narrative than his anatomy drawings but they show an interaction between the body and its environment as Leonardo's anatomy sketches are just pieces of human anatomy on a blank background. They are useful in understanding his process in regards to how he looked at the body's anatomy but his paintings and artistic drawings show the results of how he saw this body within the world. Looking at Leonardo develop his understanding of science as it parallels his art provides a unique synthesis of how the inner body and soul interact with the physical world.

Many artists in the Renaissance turned to anatomy to better their portrayal of the human form. The depth of Leonard's research on the body shows other motives beyond this superficial visual depiction. Although a pursuit in itself, it is inevitable that Leonardo's interest in physical movement does end up manifesting within his art. Leonardo studied these motions of the body as they related to inner character and the soul in the theory of *affetti*. These ideas directly effected how the body was portrayed and the atmosphere created within his art. Additionally,

Leonardo connected the soul and body to the physical world. The microcosm/macrocosm theory advanced Leonardo's understanding of the world because he could apply any properties found within the human body to the external world. In his paintings, many of which are set in nature or have a window looking out into a deep natural scene, the figures interact with the physical world. An understanding of how Leonardo viewed the body in relation to this world can provide new meanings to these paintings, especially when keeping in mind his ideas about the generative powers of nature. The *Adoration of the Magi*, *Last Supper* and *Vitruvian Man* are representative of how ideas such as the microcosm and affetti theories affect the body in art. These three pieces are during or before the period in 1487-95 when Leonardo was developing his understanding of the world through old theories such as the affetti and microcosm. After this period, Leonardo's radical change in perspective of the body in respect to the world is, as expected, just as apparent in his art. The disintegration of the macro/microcosm changes how the body appears and is interpreted in his pieces such as *St John the Baptist* painted in 1513 and his *Deluge Drawings* from 1517-18. Leonardo's understanding of the world was tightly associated with his understanding of the body but once the physical world could no longer be understood through human anatomy, nature moved into a more unexplainable realm.

Interpretations of Leonardo's notebooks involve a combination of his drawings and written notes, but due to the nature of painting, visual representation is the sole communicative power. Leonardo relied heavily on pictorial descriptions to aid his notes but his notes are also invaluable in interpreting these sketches. His

notes about his “scientific” way of interpreting the body be applied to his depictions of the body within his art.

The *Adoration of the Magi* (figure 4) is an incomplete under drawing for what would have been a painting for the Augustinian monks of San Donato a Scopeto in Florence. Started in 1481, the scene shows a seated Mary and Christ with the Magi kneeling in front in a pyramidal shape. Surrounding them is a semicircle of figures reacting to the scene. The image is set amongst ruined buildings with a single tree dividing the foreground from the background. Every piece of this painting is representative of Leonardo’s initial style, from the general atmosphere he creates, to the specific subject and figures included.

The visual subject of this piece is the arrival of the Magi and their gifts to Christ but the greater theme is that of the incarnation of Christ and God’s revelation as human.<sup>165</sup> This idea of another power within the human anatomy is a correlated theme between the *Adoration of the Magi* and Leonardo’s ideas about the body and the world in terms of the micro/macro theory. Nature, the highest creative power according to Leonardo, also manifested itself within the human body. The incarnation was one way that the inaccessible God made himself accessible to the people just as the closeness of the human body to the physical world made the physical world more comprehensible to Leonardo.

Leonardo builds his painting to reflect the mysterious incarnation, not only through Mary, Christ, and the Magi, but also through his inclusion of the spectators.

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<sup>165</sup> “4. Personal Implications of the Incarnation (Part 1) Philippians 2:5-18,” *Bible.org*, accessed April 20, 2017, <https://bible.org/seriespage/4-personal-implications-incarnation-part-1-philippians-25-18>.

The gestural nature of the spectators brings a wide variation of human physiognomy to the piece as Leonardo demonstrates the theory of affetti. The radiating response to the incarnation comes from the spectators' souls and the Magi. From old to young and beautiful to ugly, the incarnation affects all of the figures in a similar way: with awe and mystification. Leonardo's rejection of old theories of physiognomy works in a similar way, as innate qualities of the body are not indicators of the soul. The *Adoration of the Magi* does not assign moral or immoral, heavenly or unholy to the figures based on their features. They are all mystified followers of God who have come to witness his incarnation. Leonardo states, "...the figure is most admirable which by its actions best expresses the passions of its spirit".<sup>166</sup> The figures in the *Adoration of the Magi*, through their similar gestures, create the mysterious atmosphere. Their souls are all united through their common actions and "passions". The figures at random seem to create a chaotic reaction to Christ, but together, through their collective souls, this synchronization creates order.<sup>167</sup>

When the body and the world act alongside each other as one unit, there is control and peace in their interaction. This harmony was based on Leonardo's perceived understanding of the world through the human body. How the human body is portrayed in the *Adoration of the Magi* shows the unity between the body, soul, and greater powers, whether it is Christ in the biblical story or nature in Leonardo's mind, even in response to a seemingly unexplainable event. The

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<sup>166</sup> Quoted from: Blake Gopnik, "Physiognomic Theory and a Drawing by Baldassare Peruzzi 1," 1997.

<sup>167</sup> Anne B. Barriault, "Leonardo, Giorgione, Mantegna, and the Magi," *Source: Notes in the History of Art* 30, no. 1 (2010): 16.



unexplainable nature of the incarnation of Christ still unifies the spectators just as the unexplainable powers of nature are united with the soul through the physical and anatomical body.

The *Last Supper* (figure 24) is a mural commissioned by the Dominican monks and Sforza rulers of Santa Maria delle Grazie in Milan (figure 1).<sup>168</sup> There are many things that place this wall painting in a category of its own, from the revolutionary way the subject matter was treated to the condition it remains in. It is not clear when Leonardo took up the commission but he finished it in by the end of 1497 or beginning of 1498. Located in the refectory of the basilica, the painting is monumental. Leonardo's work on the piece was sporadic and as a result he painted it *a secco* (on dry plaster) on the wall.<sup>169</sup> This experimental animal fat medium and a secco execution resulted in flaking and the painting's quick deterioration. What survives today is the mere shape of the apostles because much of the tonal modeling and details have been lost. Because of this, the few preparatory drawings that exist for the piece are crucial to help fill in the gaps.

The *Last Supper's* preparatory drawings largely consist of faces and hands.<sup>170</sup> Although seemingly random, these are the areas of the Apostles and Christ that are not covered by robes and are parts of the body that are most expressive. Drawing upon Leonardo's interest in physical expression conveying mental emotions, the gestural hands of the *Last Supper* show intent and direction throughout the piece.

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<sup>168</sup> Carlo Pedretti and Kenneth Clark, *Studies for the Last Supper from the Royal Library at Windsor Castle* (Italy: Cambridge

<sup>169</sup> Linda Nichols March 15 and 2015 at 4:19 Pm, "Leonardo Da Vinci's Last Supper," *ItalianRenaissance.org*, June 21, 2012, <http://www.italianrenaissance.org/a-closer-look-leonardo-da-vincis-last-supper/>.

<sup>170</sup> Pedretti and Clark, *Studies for the Last Supper from the Royal Library at Windsor Castle*.

One of the distinguishing things about the painting is that the Apostles are reactive as Christ announces that one of them will betray him. Carlo Pedretti, one of the leading interpreters of Leonardo's notebooks and his art, states that Leonardo used "promptness and spontaneity of gestures" to express human emotion.<sup>171</sup> Leonardo's use of the body goes beyond spatial articulation and moves into mental expression, a concept in line with his interest in the movement of the soul through the body and its control over physical movement.

The Apostles also embody theories that are foundational to how Leonardo understood the body in relationship to the world. The humors are not missing from the preparatory drawings of the *Last Supper*. Each Apostle's reaction to Christ's announcement is dependent on how their soul flows from their *senso commune* throughout their body. Pedretti notes how the Apostles are "propelled into motion by the dynamic coursing of 'animal spirit' from their cerebral recesses".<sup>172</sup> This "cerebral recess" is the *senso commune* and seat of the soul. Pedretti notes how the humors carry the intention of the soul throughout the mechanical body of the Apostles. Leonardo put visual representation of this "animal spirit" into his preparatory drawings as the movement of humors flowing through the bodies. In his notebook's Leonardo states, "When you make a figure, think well about what it is and what you want it to do, and see that the work is in keeping with the figure's aim and character".<sup>173</sup> In line with this concept, the Apostles' motions represent their different characters and temperaments. The preparatory drawing for St. Simon

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<sup>171</sup> Ibid, 58.

<sup>172</sup> Ibid, 179.

<sup>173</sup> Ibid, 72.

(figure 25), although it is most likely a copy done by one of Leonardo's pupils, shows a distinct vein across his forehead. This pulse of blood that reverberates across the forehead of Simon connects the mental to the physical. Starting within his brain, his soul is carried through his body to his muscles and thus controls his "mental motions". This incorporation of the humors into the *Last Supper* creates a strong connection between the Apostles' bodies and their world.

Just as the soul moves through the body through vessels and channels, water flows through the earth like blood. Leonardo used this connection between the body and the world to help him understand the processes of the bodies he was dissecting. Leonardo said, "The water which rises in the mountains is the blood which keeps the mountain in life".<sup>174</sup> Water, as it is analogous with blood, carries the soul of the world around the earth. Leonardo's drawing of the *Vitruvian Man* is a model of how he thought of the body as an analogy of the world (figure 10). This image of a man inside a circle and a square comes from Vitruvius's introduction of Book III on Temples, an ancient architect who believed that the divine proportions of the human body could be used to create divine proportions of a building.<sup>175</sup> Leonardo's interpretation connects body proportions with architecture but also has more profound implications in the body's relationship to the natural world.

Rudolf Wittkower, an influential scholar on Renaissance architecture, asserted that the revival of Greek mathematics during the Renaissance provides a

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<sup>174</sup> Edward MacCurdy and Leonardo Da Vinci, *The Notebooks of Leonardo Da Vinci*, vol. 1 (New York: Reynal & Hitchcock, 1938), 77.

<sup>175</sup> Martin Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man* (Oxford: Oxford University Press, 2006), 97.

base to interpret the circle and square that the *Vitruvian Man* stand in.<sup>176</sup>

Wittkower states that the geometric properties of the square lend it to represent the Earth. Series of four including the “four elements, four temperaments, four seasons, four times of day” that are common with the earth correspond to the sides of the square.<sup>177</sup> In contrast to this, qualities of the circle, including its continuity and “single center” parallel the divine. Although “divine” is usually thought of in the context of religion and God, as previously stated, Leonardo assumed nature to be the highest creator and so, in the *Vitruvian Man*, divinity takes on a new meaning. The circle is not necessarily heavenly but instead it represents Nature that Leonardo refers to as the “Creator” or “Master” in his notebooks.<sup>178</sup> Having the body placed between the physical earth and the “Master” of earth (Nature) puts the physical body between the physical world and its governing laws. The human body is the microcosm or essentially another entity where governing laws act within a physical body.

Another unique quality about Leonardo’s *Vitruvian Man* is the dual positioning the figure adopts. Highlighting the movement of the body within the circle and square, Leonardo alludes back to the soul. The soul controls the movement and positioning of the body as an expression that is derived from its interpretation of the world through the senses and into the *senso commune*. The *Vitruvian Man* shows the close relationship between movement, the microcosm, and affetti theories.

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<sup>176</sup> David Rosand, “Reading the Figure,” *Source: Notes in the History of Art* 31/32, no. 4/1 (2012): 38.

<sup>177</sup> *Ibid*, 42.

<sup>178</sup> MacCurdy and Da Vinci, *The Notebooks of Leonardo Da Vinci*, 169, 104.

The *Vitruvian Man* is based in Vitruvian theory but Leonardo changes the context of where humans are situated within the world. Instead of using an “ideal body” to interpret proportions of divinity, Leonardo uses the human body in general as an ideal creation of Nature. Using Leonardo’s notes as context we can apply this new concept of divine to be Nature instead of a heavenly divine.

In addition to ancient Greek geometry, Leonardo used theories and his interpretations of the four humors to connect the human body to the physical world. Wittkower’s thesis in connecting the architecture and geometry of the *Vitruvian Man* states that the “...Vitruvian figure inscribed in a square and a circle became a symbol of the mathematical sympathy between microcosm and macrocosm.”<sup>179</sup> In the period around 1490, Leonardo was interpreting human anatomy to function via natural laws and in a sense how the circle (Nature as the divine creator) acts upon the square (the physical world). The man in the drawing is placed at the center of both the circle and square and thus in between the physical world and the laws that modify the earth and the human body. The connection between the physics of water and the blood of the body is one example of how the circle (the physical forces acting upon water) work with the square (the water) and the human body (the blood).

The second block of Leonardo’s anatomy studies (1504-09) there begins to be a change in how he approaches the human body and after the third block (1510-1513) Leonardo contextualizes the body with a different relationship to Nature. This dramatically different association of the body is prevalent within the art that

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<sup>179</sup> Rosand, “Reading the Figure”, 38.

Leonardo was creating concurrently. As he turned toward a more empirical approach in dissecting the body he became unhindered by old theories and saw the body for what it was and how it was actually functioning. With this approach, the body dissociated from the physical world and the laws acting upon it. The work that Leonardo did in understanding the body could no longer be applied to understand the physical world and former “truths” about the world moved further away from empirical understanding.

Leonardo’s only complete painting that was painted after 1508 is *St. John the Baptist* (figure 26).<sup>180</sup> This piece is considered his last painting and as to its origins, there is debate as to whether it was painted in France or not and no specific commissioner is known.<sup>181</sup> The heavily shadowed piece shows an effeminate St. John draped in a fur and pointing up to heaven to prophesize the coming of Christ. The figure of St. John comes through from heavy *chiaroscuro*. The nature of this painting is ver different from any of Leonardo’s other paintings. His previous paintings, especially those with religious subjects, are all deeply tied to nature. Whether the scene takes place in a natural setting or there is a window that looks out to a deep background. *St. John* is of a religious figure completely removed from the physical world. He is also a fleshy figure with a lack of distinct anatomy. This stripping of anatomy and nature parallels Leonardo’s new belief in the detachment between the human body and the natural world. St. John’s surrounding has been

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<sup>180</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 336.

<sup>181</sup> Kenneth Clark, *Leonardo Da Vinci An Account of His Development as an Artist*, 2nd ed. (Cambridge: Brook Crutchley, University Printer, 1952), 171.

cast into shadow as Leonardo works to reinterpret the body's place amongst the material world.

*St. John the Baptist* no doubt holds an unattainable air of mystery about it. This simple figure lacks excessive symbols or iconography and so aside from the direct religious interpretation about St John, his gesture, and expression, there is room for interpretation in regards to the role of his body. The ambiguity that Leonardo leaves *St. John* with punctuates the mystery of the divine. Instead of Leonardo's previous interpretation of the divine as nature, the indistinct role of *St. John's* body within its physical world alludes to further questions and interpretations of how the body is related to the physical. Looking at how Leonardo viewed the body during the second half of his anatomy studies, we know that as the body diverged from the world, Leonardo's understanding of the world became less and less concrete until he acknowledged that other forces of creation could be at play. Nature's role as the creator was thrown into question and so Leonardo's understanding of how the world works through physical observation was limited. Kenneth Clark remarks how the only certain interpretation of *St. John* is its uncertainty. He calls the piece a "question mark, the enigma of creation".<sup>182</sup> Although many of Leonardo's pieces are of religious figures, they all have a relationship to their setting in nature but the only relationship *St. John* has to a location is through his gesture that points up. *St. John* points up to the heavenly, showing that there are other realms that potentially have the ability to "create" aside from nature. Clark refers to *St. John the Baptist* role as a witness to the truth

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<sup>182</sup> Kenneth Clark, *Leonardo Da Vinci An Account of His Development as an Artist*, 2nd ed. (Cambridge: Brook Crutchley, University Printer, 1952), 173.

and light of Christ and with this argues that a question is the precursor of truth. *St. John* is the precursor to truth. He is the furthest reach of truth that Leonardo believed people could contemplate. St. John sits on the edge of creation throwing heavenly divine back into question as the ultimate “Creator”.

Martin Kemp ties a similar theory back to Leonardo’s concept of empiricism to reconcile Leonardo’s relationship with religion and his ideas about natural causation within the physical.<sup>183</sup> Citing the readings of Albertus Magnus, an 11<sup>th</sup> century Dominican friar and Catholic bishop, Kemp refers to the idea of “mysterious speculation” as an idea that “the mind can extend its understanding to all the causes and effects in the physical spheres of the observable universe, but outside this nothing is rationally knowable to finite intelligence”.<sup>184</sup> Being able to recognize that nature is not the “supreme Creator” of the human body and the physical world opened up a realm that Leonardo had to acknowledge as unattainable to the mind. Leonardo uses St. John to represent this world but his representation of St. John denies the viewer answers just as he refuses to create answers for ideas beyond his grasp. In the period surrounding the painting of *St. John*, 1510 and later, Leonardo’s understanding of the world started to become shroud in mystery and that which he could not verify through empiricism he left for “...the friars, the fathers of the people, who by inspiration know all the mysteries”.<sup>185</sup> St. John’s knowing smile indicates the presence of these “truths” that Leonardo leaves for others to contemplate just as St. John knew the coming of Christ before others.

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<sup>183</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 339.

<sup>184</sup> *Ibid*, 339.

<sup>185</sup> Martin Kemp, “Dissection and Divinity in Leonardo’s Late Anatomies,” *Journal of the Warburg and Courtauld Institutes* 35 (1972): 200–225, doi:10.2307/750929, 212.



Leonardo's last series of sketches were drawn in 1515, 4 years before his death in 1519.<sup>186</sup> Known as the *Deluge Drawings*, these 16 sketches show a destructive storm with violent swirls of black chalk that give direction to wind, rain, and clouds. Only one drawing shows the presence of people, and even so the storm is of such great scale that humanity is left small and at mercy to the storm. Although not ruled out as an interpretation, Leonardo never references any specific biblical floods to describe his Deluges but Kemp considered the classical deluges of Virgil's *Aeneid* and of Ovid's *Metamorphosis*. In all of these classically based interpretations of the flood there is another hand at play that initiates the waters whether it is Juno, Ovidian wind gods, or other gods.<sup>187</sup> Often times these figures are used in replacement of the storm itself, for example the figure of Noah is enough to allude to the flood. Whether or not the flood is biblical in nature, the only figures Leonardo draws within this series are by no means allegorical figures of the storm. In line with the divergence of the body from the world, no human can represent the forces acting upon the earth. Leonardo only depicts what he can see and understand which is limited in this case to his knowledge of hydraulics.

Extending the interpretation of *St. John the Baptist* and the mysteries of the divine, Leonardo brings this realm back down to collide with the physical. The implications of not knowing and not being able to understand the greater powers in the universe are considered in the Deluge series. Kemp claims that Leonardo used concepts of Aristotelian dynamics to comprehend what created these forces that lifted water into the air in such a catastrophic way. This model "presupposed that

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<sup>186</sup> Kemp, *Leonardo Da Vinci The Marvelous Works of Nature and Man*, 316.

<sup>187</sup> *Ibid*, 319.

motion could only be given to an inert body by an external agent, since rest was the natural state” and yet after describing a series of causes to explain one movement, there still had to be an “ultimate cause” that set the whole chain reaction into motion.<sup>188</sup> Leonardo recognizes this force as the “prime mover” through his “dynamic theory” (where movement is the result of an external mover) but he determines this “prime mover” to be indefinable.<sup>189</sup> This ultimate force is indefinable because of its lack of physicality. Leonardo’s reliance on empiricism to provide answers restricted the definability of a force that could only act up the physical but was not physical in itself.

Leonardo’s Deluges show the lack of control that people have over forces at play within the world. Leonardo believed that he could reveal the intentions of a body by describing it and looking at it empirically but the idea of a “prime mover”, something unable to be explained empirically, takes away the understanding of the effects of nature. As divine is shroud in mystery, control is taken from people. The intimate tie that Leonardo originally believed the body to have with the world was severed and unexplainable forces start to act *upon* the body, instead of *with* the body, as he previously thought. Understanding the body as a piece of nature that is subjected to forces beyond its control is very different from ideas that surround earlier pieces such as the *Vitruvian Man* where the body is representative of the world. Leonardo’s understanding of the power of water is clearly a generative force behind these drawings. What Leonardo did understand about the physical properties of world is not negated but it is separated from the body and separated

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<sup>188</sup> Ibid, 319.

<sup>189</sup> Ibid, 320.

from other greater generative powers that Leonardo could not understand. Along with the human body, other themes can be traced through Leonardo's studies, in particular water. Contrasting the *Deluge Drawings* with one of his first drawings, *The Study of the Tuscan Landscape of the Arno Valley* (figure 1), shows the result of this alternative theory about the world. With the body analogous to the world and the perceived holistic understanding of the world, there is peace and synchronism between the water and land. As the body becomes its own entity and answers in regards to the world seem more unattainable, Leonardo grapples with the tensions between the body, world, and water as seen in his deluges.

Whether it is the *Mona Lisa* hanging on the wall at the Louvre or a sketch of one of Leonardo's flying machines, to consider his art, science, and philosophy in isolate is to ignore its influential factors. His pieces are a culmination of everything that occurred before them and the ideas that were present in society at the time. Not only are they reliant of external factors, they are products of Leonardo's internal process of discovery. This is the problem that people run into when looking at the *Deluge Drawings*. It is true that when looking at a timeline of Leonardo's art, they seem like the catastrophic end of the world and many people, including Kenneth Clark, a Leonardo da Vinci scholar and Anthony Blunt, an Italian art theorist, see these deluges as a reflection of Leonardo's state of mind.<sup>190</sup> This interpretation of the "depressed artist" only considered the obvious subject of the drawings, Leonardo's age, and how it is different from his other works. Instead, looking at these pieces in regards to their similarities with his other works and studies along

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<sup>190</sup> Martin Kemp, "Late Leonardo: Problems and Implications," *Art Journal* 46, no. 2 (1987): 94–102, doi:10.2307/776886.

with the common themes that Leonardo starts to adopt during this time provide a better context to interpret these sketches.

Leonardo did not necessarily correspond the end of his life to the end of the world. In fact, according to his notebooks, he actually believed the world to end in a great drought.

The rivers will remain without their waters; the fertile earth will put forth no more her budding branches; the fields will be decked no more with waving corn. All the animals will perish, failing to find fresh grass for fodder; and the ravening lions and wolves and other beasts, which live by prey will lack sustenance; and it will come about after many desperate shifts that men will be forced to abandon their life and the human race will cease to be.<sup>191</sup>

Destruction is not the waters only role within the deluges. Understanding Leonardo's other pursuits, especially hydrodynamics, give greater awareness as to how water can function within his pieces. It is the greater force of water and exerted on water, not solely its destructive power, which Leonardo was exposing. A common theme within Leonardo's understanding of the body's relationship to nature are the forces working either within or surrounding the human body. These forces, whether Leonardo could directly comprehend them or whether he considered them unexplainable, directly bound his art with science. A holistic consideration is necessary when looking at an artist as complex and dynamic as

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<sup>191</sup> Edward MacCurdy and Leonardo Da Vinci, *The Notebooks of Leonardo Da Vinci*, vol. 1 (New York: Reynal & Hitchcock, 1938), 79.

Leonardo. While he seems to be an enigma of his time, his work advances with continuity.

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## Illustrations



Figure 1. Leonardo da Vinci, *A study of the Tuscan Landscape of the Arno Valley*



Figure 2. Andrea del Verrocchio, *Baptism of Christ* with enlargement of angels

Figure 2. Andrea del Verrocchio, *Baptism of Christ*

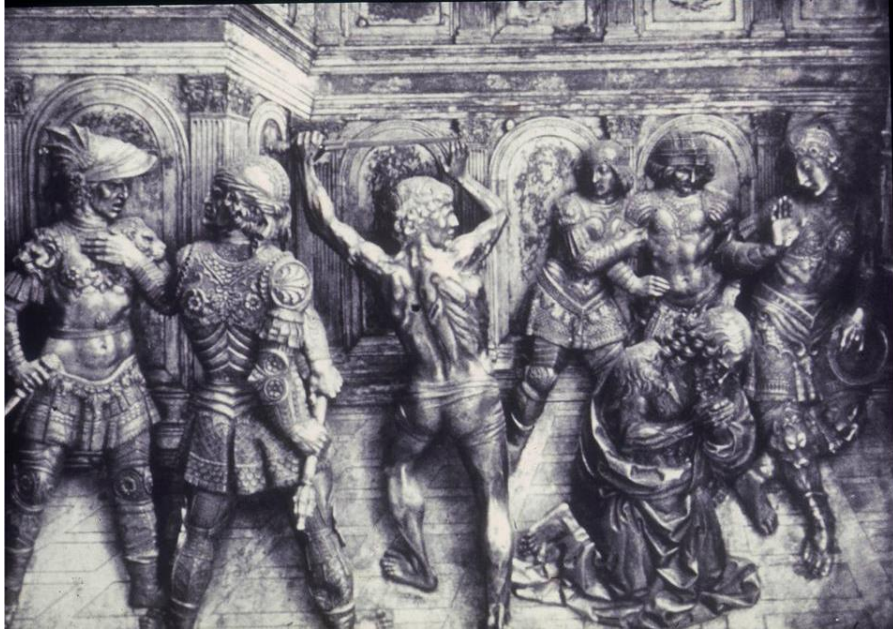


Figure 3. Andrea del Verrocchio, *The Beheading of St John the Baptist* (detail of altar)



Figure 4. Leonardo da Vinci, *Adoration of the Magi*

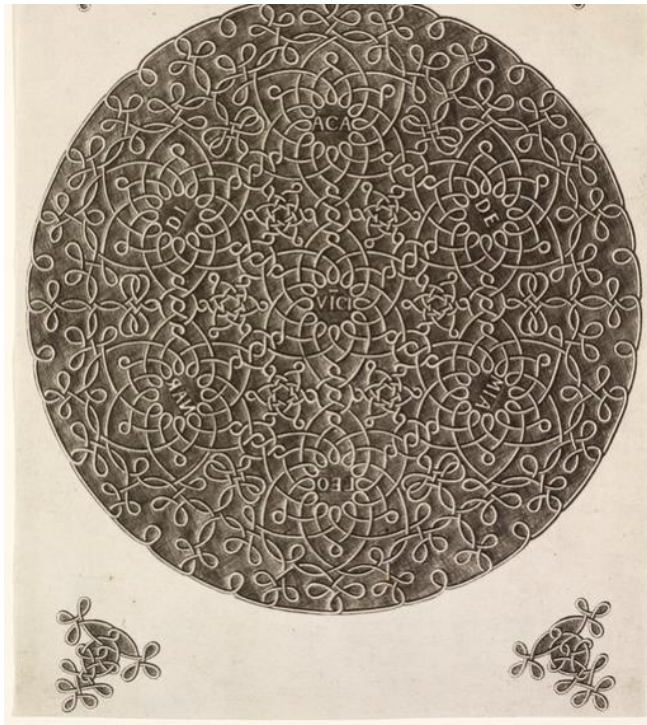


Figure 5. Leonardo da Vinci, *Knot Pattern*



Figure 6. Leonardo da Vinci, *5 Caricature Male Heads*



Figure 7. Leonardo da Vinci, *Study of Water Hitting a Wall*

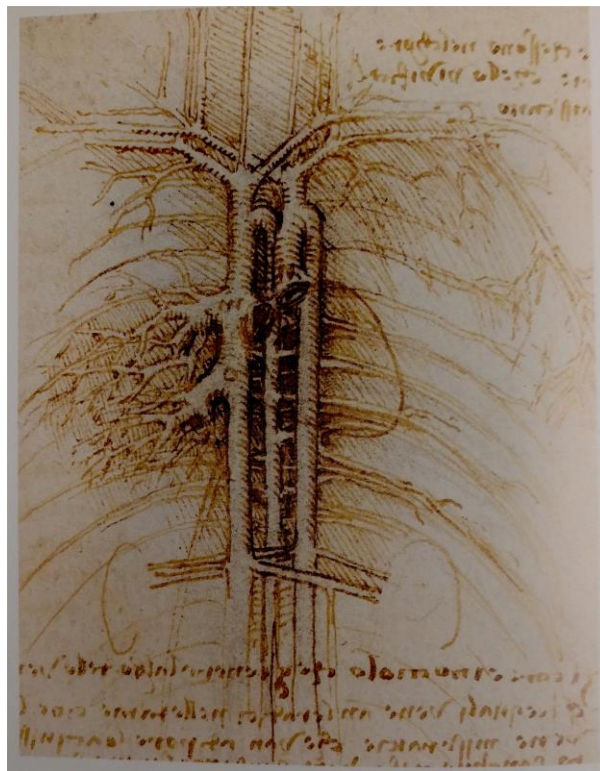


Figure 8. Leonardo da Vinci, *The Cardiovascular System*

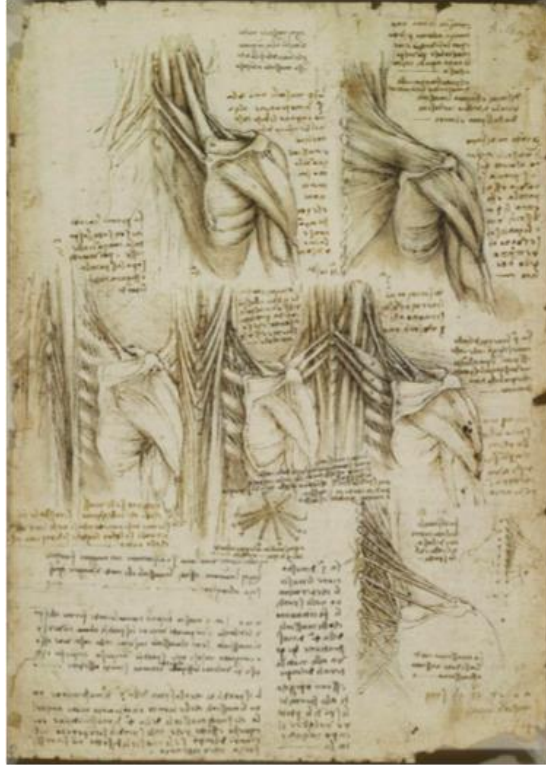


Figure 9. Leonardo da Vinci, *Muscles of the Upper Spine*

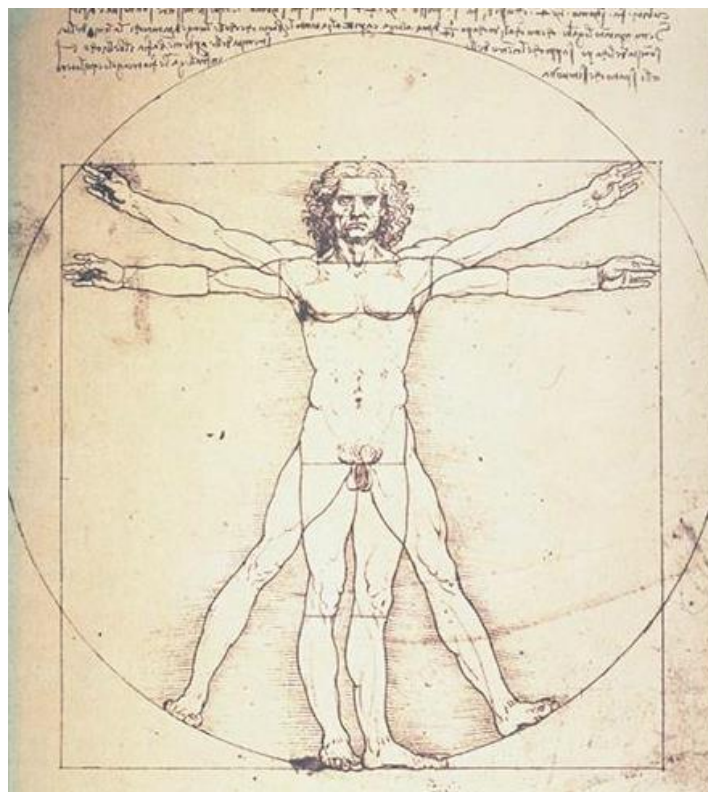


Figure 10. Leonardo da Vinci, *Vitruvian Man*

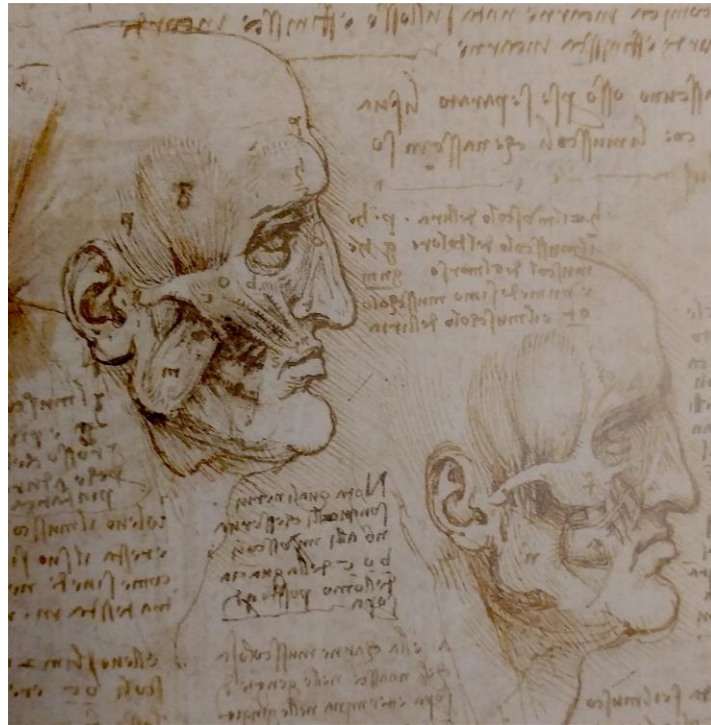


Figure 11. Leonardo da Vinci, *The muscles of the face and arm*



Figure 12. Leonardo da Vinci, *The superficial anatomy of the shoulder*







Figure 14. Leonardo da Vinci, *Skull in Median Section*



Figure 15. Leonardo da Vinci, *Coition of a hemisected man and woman*

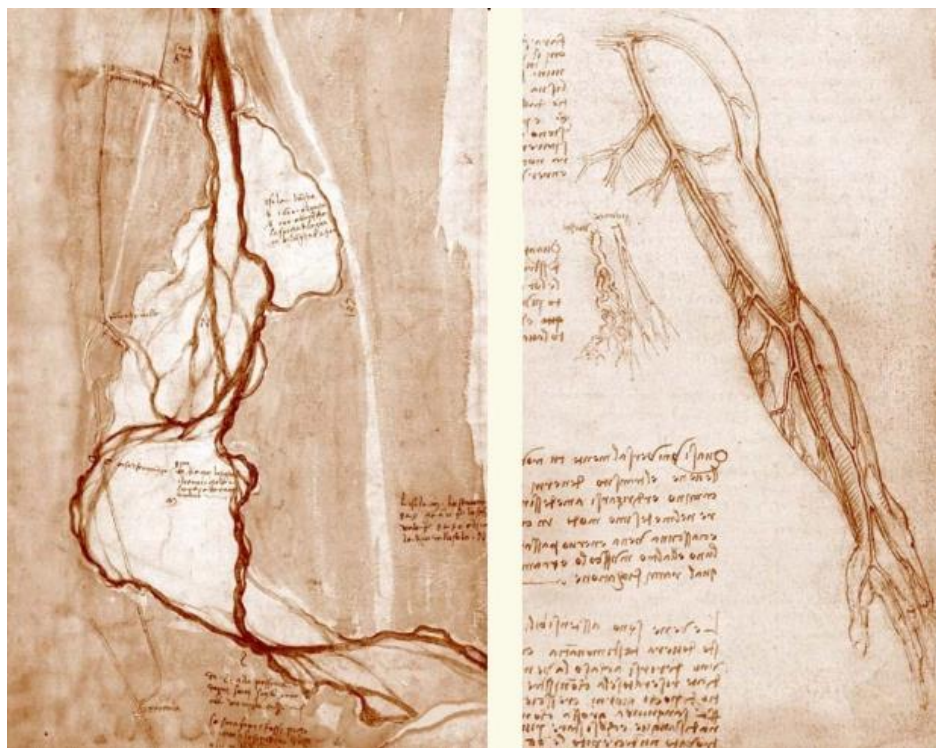
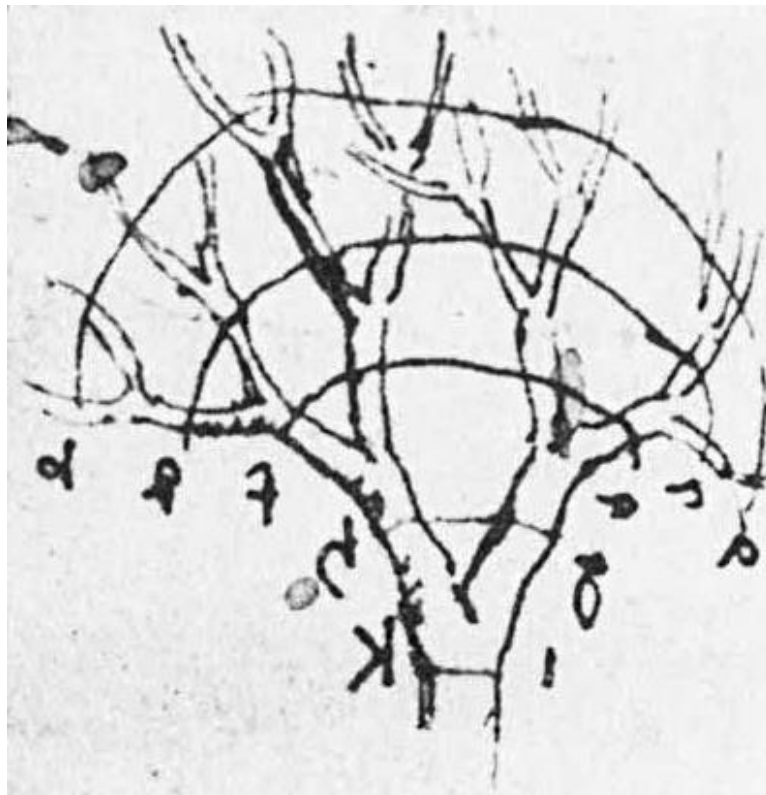


Figure 16. Top: Leonardo da Vinci, *Diagram of the growth of a tree*  
 Lower left: Leonardo da Vinci, *the River Arno*  
 Lower right: Leonardo da Vinci, *the veins of the left arm,*



Figure 17. Leonardo da Vinci, *Study of horses, a lion, and a man*



Figure 18. Leonardo da Vinci, detail of a horse and human moving forward

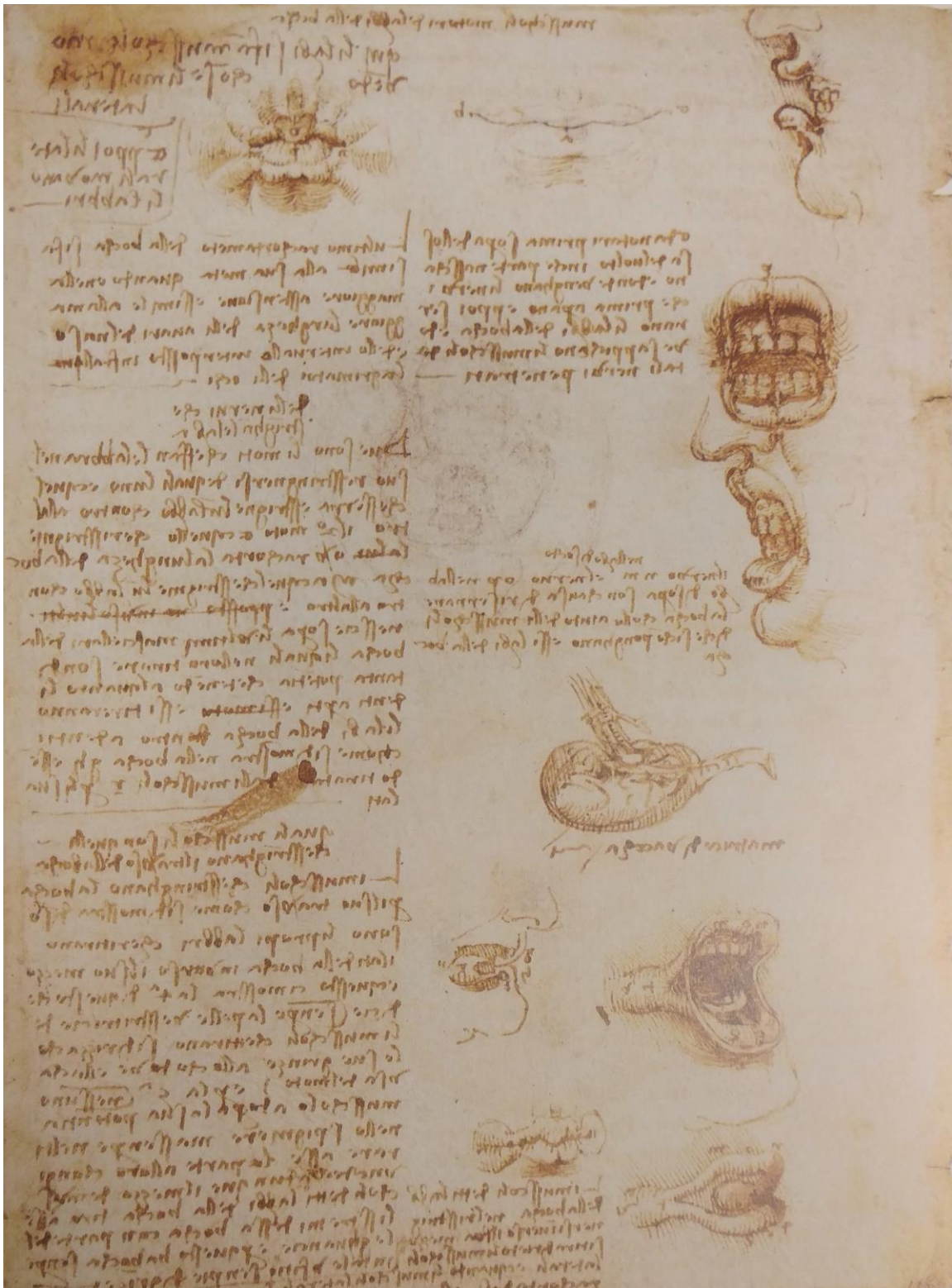


Figure 19. Leonardo da Vinci, *The Motor Muscles of the Lips of the Mouth*

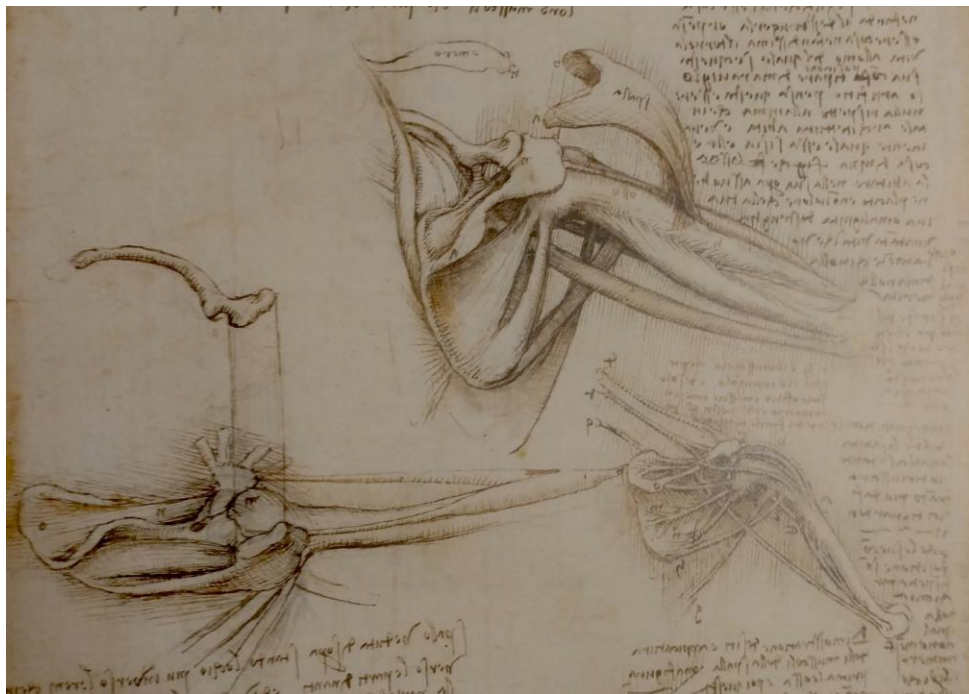


Figure 20. Top: Leonardo da Vinci, *The vertebral column*  
 Bottom: Leonardo da Vinci, *The bones and muscles of the shoulder*

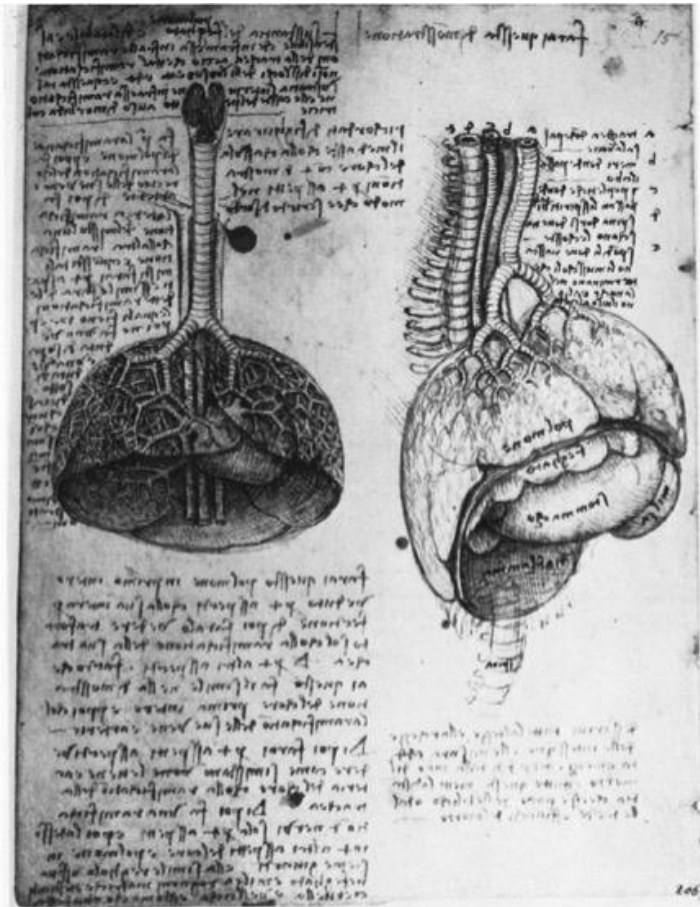


Figure 21. Leonardo da Vinci, *Respiratory organs in isolation*

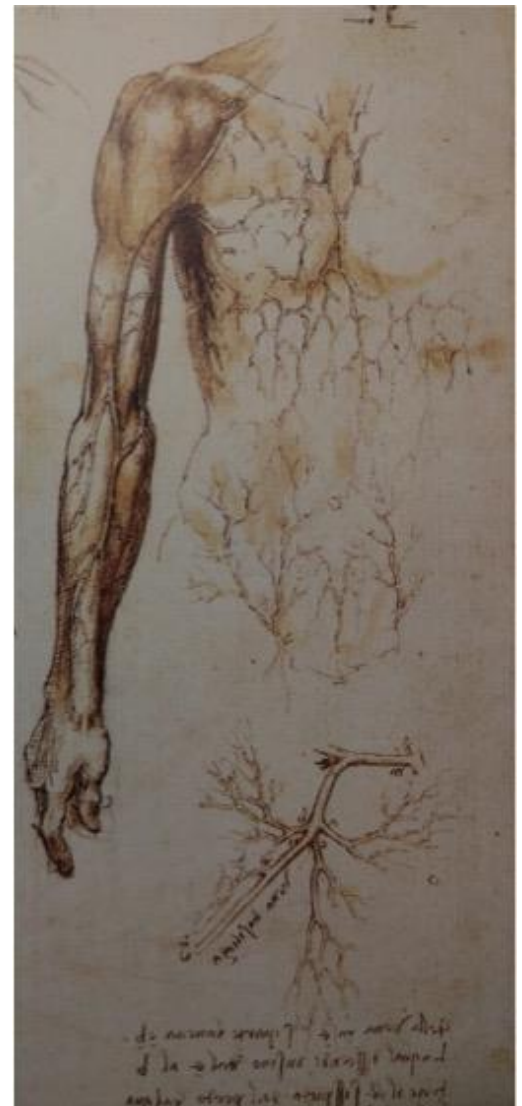


Figure 22. Leonardo da Vinci, *Muscles of the arm, and the superficial vessels*



Figure 23. Leonardo da Vinci, *The cerebral ventricles, the brain, sagittally sectioned and opened out*

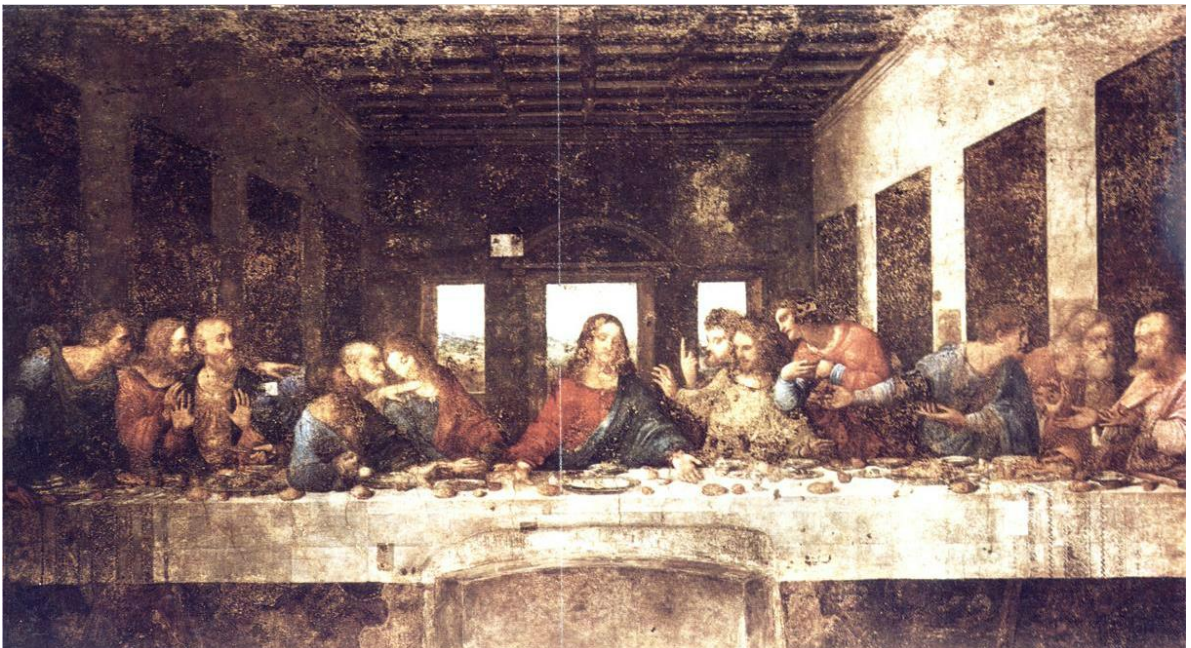


Figure 24. Leonardo da Vinci, *The Last Supper*



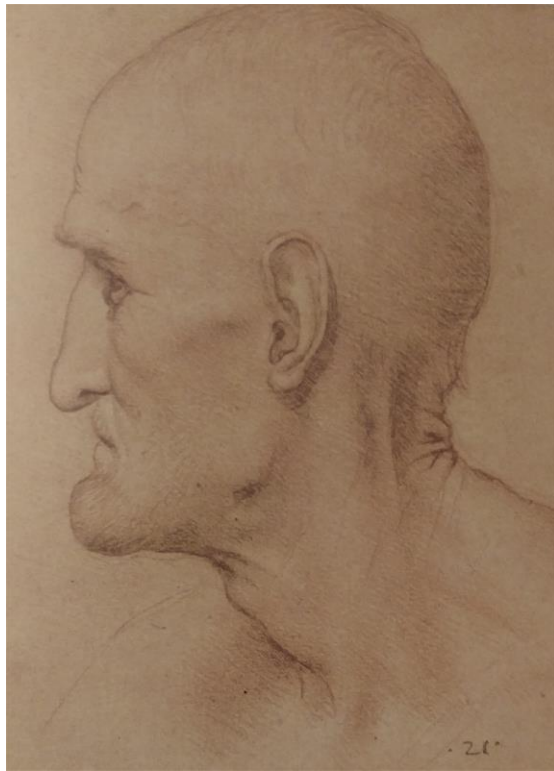


Figure 25. Pupil of Leonardo, *Preparatory drawing for St. Simon*



Figure 26. Leonardo da Vinci, *St. John the Baptist*

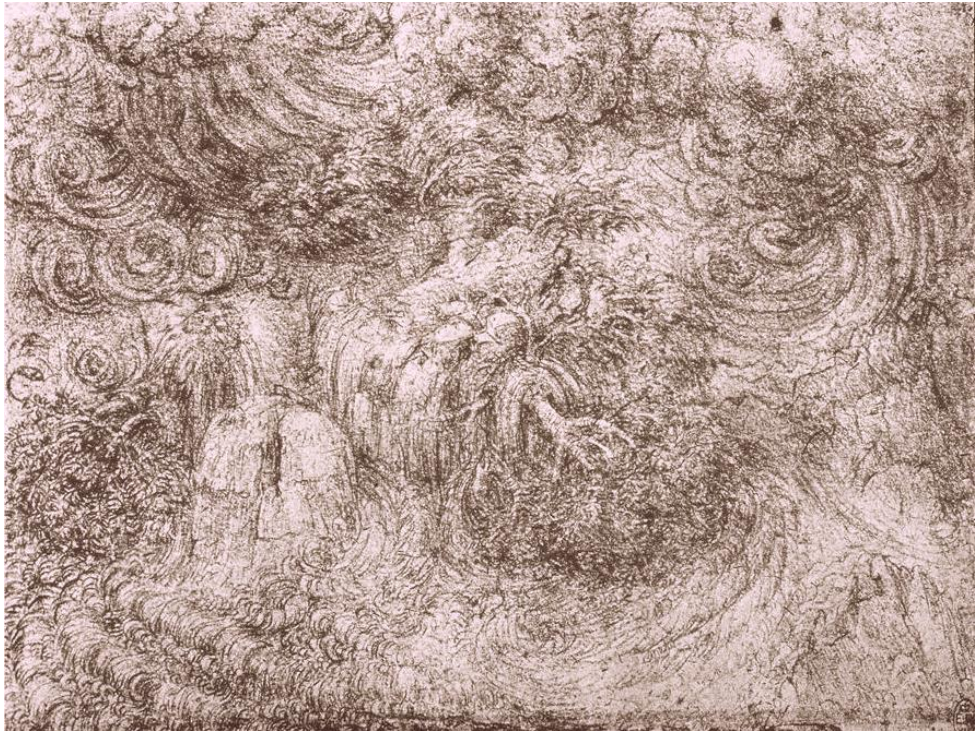
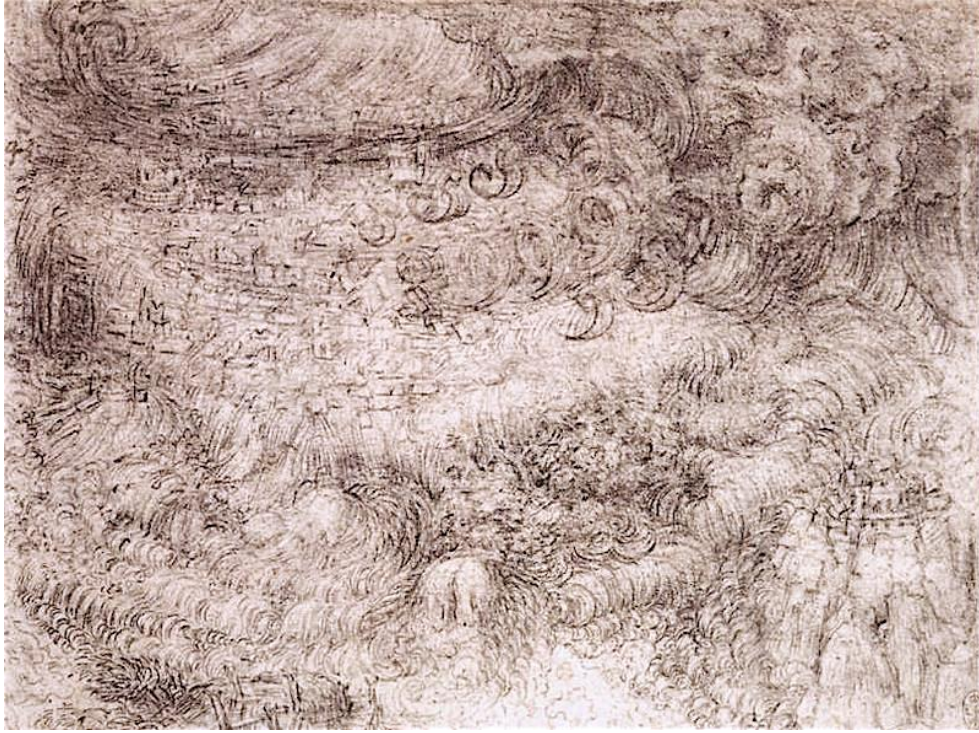


Figure 27. Top: Leonardo da Vinci, *Deluge over a city*  
Bottom: Leonardo da Vinci, *Deluge over Rocky Windsor College*