

Renaissance Robotics: Leonardo da Vinci's Lost Knight and Enlivened Materiality

by Anne Pasek

Abstract: René Descartes posits a curious anxiety his *Second Meditation*—that an otherwise convincing form might conceal a post-human robotic entity. Machinic and animalian bodies, in his dualistic perspective, were seen to exist on a lesser order than the soul of man. Yet, as Descartes himself seems to wonder, the maintenance of this divide is a fraught endeavor when automata can mimic human shape and movement. The question of animate materiality is curiously echoed in the earlier writings of Leonardo da Vinci. These fellow thinkers and tinkerers agreed on the analogous principles between bodies and machines, yet they are at odds as to the implications of these beliefs. What da Vinci's anatomical studies, robotic prototypes and treatises on art suggest is the far more radical possibility of material bodies and souls, conjoined in sensation and movement. In this flat ecology of bodies, machines and spirit, Leonardo's robots suggest a radical alternative to our Cartesian inheritance.

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René Descartes, the formative Enlightenment scholar and proponent of modern rationality, posits a strange question in the epistemological treatise of his *Second Meditation* (1637). Doubting the eye's capacity to deliver empirical knowledge solely through its material access to the world, the philosopher notes: "I chanced... to look out the window, and see men walking in the street; now I say in ordinary language that I 'see' them... [But] what can I see besides hats and coats

which may cover automata?"¹ This curious anxiety—that an otherwise convincingly shaped human form might conceal a post-human robotic entity—was not a new feature of Descartes' era. Automata and trick statues were commonplace courtly objects in the aristocratic society of the time. The intellectual climate he helped cultivate, however, changed the automata's valence from an object of delight to an illustration of a rather more sinister possibility. A Cartesian Europe was one firmly entrenched in a dualistic approach to human and post-human life, whereby the material bodies of animate things were derisively reducible to their technological and anatomical parts, save for the singular, transcendental and autonomous mind granted by God to mankind.² Animals and machines, therefore, were seen to exist on a distinct and lesser order than man. Yet, as Descartes himself seems to wonder, the maintenance of this divide is a fraught endeavor when automata can mimic human shape and movement.

This question of animate materiality is curiously echoed in the earlier writings of another scholar of bodies and minds: Leonardo da Vinci, the famed Renaissance artist and engineer. Both thinkers saw intriguing parallels between the study of natural law and that of applied mechanics.³ To Descartes, the body was merely a machine designed by God, piloted by the autonomous mind and legitimated by mathematics.⁴ The relationship of the mind to the body was therefore often idealized as one of suspicion or remove.⁵ To Leonardo, the body was also a harmoniously proportioned "marvel of artifice," but one that the soul departed from only with "great wailing and lamentation."⁶ These fellow thinkers and tinkerers of automata thus agree on the analogous principles between body and machine, yet are at odds as to the implications of these beliefs. Whereas a dualistic divide between mind and body runs through the writings of both men, how they imagine the possibilities for a meaningful relationship between mechanical and spiritual matter stand in stark contrast. It is thus important to expand the history of automata to include the contributions of Leonardo da Vinci and other earlier thinkers so as to broaden our historical understanding of human materiality. What Leonardo's anatomical studies, robotic prototypes and treatises on art suggest is the far more radical possibility of an enlivened materiality that dramatically imbricates bodies and souls in conjoined sensation and movement. These implications, largely absent from the histories of art and science, start at the border between the two, and propose to animate the study of bodies in motion.

Automata and the Rational Body

The standard account of automata, as conveyed by scholars of the history of science, suggests a narrative of continuity that begins with the ritualistic automata of the Greeks, reached a turning point with Descartes' mechanization of the body, and finally evolved into different and productive technologies through the triumph of reason over superstition. Silvio A. Bedini, for example, celebrates automata as the "first complex machines" of (Western) civilization, part of a teleological lineage of progress that links early puppets to space age cybernetics, thereby fulfilling the "original aims" of all technology: "the reduction or simplification of physical labour."⁷ Derek de Solla Price, similarly, describes a linear "road of evolution" wherein automata serve as the "progenitors of the Industrial Revolution."⁸ According to this view, these technological marvels, while borne of a primitivist and animistic impulse, nevertheless provide the means through their mechanics to overcome pre-modern naiveté and embrace a rational and mechanistic world view.⁹ In this developmental history, Descartes' role is one of a visionary and a transitional figure; "one who stands on a height scaled and begins the ascent to the next plateau."¹⁰ As a key intellectual player at a moment of paradigmatic shift, Descartes' view on automata ushered in an era that arguably extends to our own: an account of material skepticism and machinic automation against which the only exceptional object is that of the human soul.

Indeed, as is often the case when writing histories of teleological triumphs, the automata of Descartes' period confirm this narrative of rational progress and industrialization. As Alexander Marr describes, the treatises and texts concerning automata in the late sixteenth- and early seventeenth-century evince a shift in their approach to the technology and its accompanying wonders. As mechanical arts lost their esteem and the value of wonder came into tension with autonomous human reason, authors and inventors of automata developed an argumentative program to justify through noble curiosity and mathematical principles what might otherwise be seen as a duplicitous ruse.¹¹ Moreover, the subsequent automata of the Enlightenment, Simon Schaffer notes, continued this call to reason heavily imbricated in the epistemic and economic project of industrial reform. Viewing the "active gesture" of workers as an embodied source of knowledge, the mechanization of such tasks was seen as an important way that labor could be rationalized and made visible.¹²

This project led to a variety of mechanical and symbolic applications of automata, appearing variably as metaphors for social order, ideal workers, or Enlightened governmentality.¹³ This reformist program succeeded in promoting the machinic ethos of rationality to the extent that it began to arouse concerns from philosophers. The ascendancy of the machine led to a rise in baleful androids in literature, theological reactionaries decrying the atheistic threat of human machines, and anxieties about the continued value of human life in the face of a seemingly perfect robotic ideal.¹⁴ The transformative potential of automatized systems and a concomitant resurgence of human exceptionalism thus characterizes the social and technological climate of a post-Cartesian Europe.

However, what has been crucially left out of this account is an attentive history of earlier automata in the context of their own time. This lacuna exists for multiple reasons: a poverty of surviving artifacts, the somewhat low-culture address of automata entertainment, and a rebuffing attitude from traditional art historians due to the works' technological nature. Moreover, these mechanical curios, if not part of a narrative of progress and technological mastery, are somewhat embarrassing to traditional scholars of science, as they are decidedly antithetical in their relation towards the reduction or simplification of physical labor. Early modern automata are artfully complex, often serving no other purpose than to induce emotional reactions of wonder, delight and surprise. While the late Renaissance and Enlightenment automata can be seen to adapt and model their contemporary rational values, their origins do not lie there. These are the survivals of an earlier form, one whose purpose and expression can be traced back to the likes of Leonardo da Vinci.

The Renaissance's Lost Robots

Leonardo's contributions to this somewhat occluded field of early automata are fragmentary. Rather than an outlying curiosity, however, automata represent a logical subject of pursuit for this prototypical Renaissance man. Sketches of mechanical and kinesiological principles abound in Leonardo's codices and inform his technological and artistic outputs in equal measure. Notes and anecdotes from his time suggest that several automated devices, from a moving lion to a bell-ringing hydraulic clock figurine, were planned and partially executed by the artist and inventor. Perhaps the most spectacular of these drafted robots lies in the designs for a



Figure 1. Mark Elling Rosheim, *Knight Redrawn with Renaissance Armor*, 1997. *Leonardo's Lost Robots*. Image courtesy of Springer Verlag.

mechanical, articulated human in the Codex Atlanticus. Speculatively reconstituted by contemporary roboticist Mark Elling Rosheim with the assistance of Leonardo scholar Carlo Pedretti, "Leonardo's Robotic Knight" has only recently become a physical and conceptual object of study (fig. 1).¹⁵ Described by Pedretti as "the first articulated humanoid robot in the history of Western Civilization," it thus presents a fitting interlocutor through which to address the Cartesian anxiety about the human body and its mechanization.¹⁶

The device, existing today only as fragmentary designs and modern recreations, is suspected to have been realized in 1495 under the patronage of Ludovico Sforza, then duke of Milan. Based on multiple sketches of gearing and pulleys, the fully realized knight is expected to have been able to independently sit up and open and close both its arms and helmet visor.¹⁷ While it features three degrees of freedom in the articulation of its legs and four degrees of freedom in the articulation of its arms and wrists, these components were all designed to move in unison. The knight, when activated, would spring upright while simultaneously closing its arms in a lateral, pectoral embrace. An analogue programmer made of a worm gear and rotating drum cam in its chest carefully controlled its movements and powered its arms, while the legs derived their force from an external crank and cable arrangement (fig. 2). Cloaked in a suit of armor, the robot's mechanical nature was likely concealed, creating a surprising encounter between Sforza's guests and this unknown entity. Perhaps banging a drum, revealing a gruesome face, or grabbing an unsuspecting passerby into a shocking embrace,¹⁸ Leonardo's robotic knight might be seen to embody the humanist fear of an inhuman android seeking to menace its creators.

The deployment of such alarming tactics, however, should be contextualized into Europe's larger history of palatial entertaining. As art historian Genevieve Warwick notes, villa decor of the fifteenth-century was often arranged as a theatre for interactive and

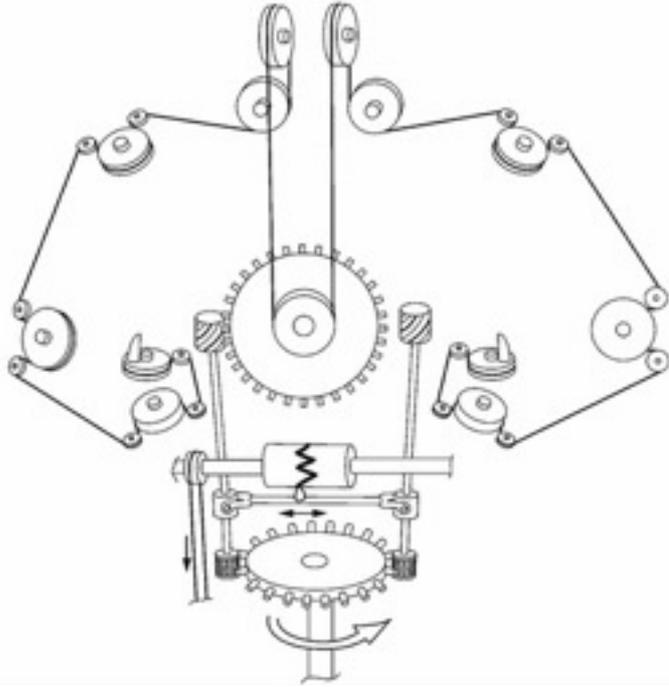


Figure 2. Roshiem's speculative model of the knight's internal gearing. *Leonardo's Lost Robots*. Image courtesy of Springer Verlag.

performative viewing.¹⁹ Guided by a knowing resident, visitors might be solicited into double-takes, visual traps, and embarrassing juxtapositions in a game of spatial trickery and artistic deceit.²⁰ In and amongst accounts of shocking statues, interpretive poetry and titillating myths were a growing number of automata within this theatre of movement and emotion. The seventeenth-century Villa Borghese, for example, featured a frightening jack-in-the-box that forcefully competed for attention amidst the palace's esteemed art collection. The furniture itself was also suspect; hapless users might become entrapped by one of the Borhese's trick chairs.²¹ The Chateau de Hesdein, conversely, enjoyed a long history of "frolicsome engines" stretching from the end of the thirteenth-century to the fifteenth, whereby statues and inconspicuous machines variably besmirched guests

with squirts of water, flour, soot or even physical blows.²² As historian Jessica Riskin notes, sixteenth-century Europe was abuzz with such entertainments, which gradually became a commonplace device of aristocratic estates.²³ Evermore astonishing to the modern reader, these somewhat malicious-seeming jokes neither ran thin nor were received in bad spirits.²⁴ Present echoes of Cartesian anxiety are absent from such accounts. Instead, Riskin suggests that spectators and targets were enchanted by the whimsicality and vitality of such machines, "delighting in a base corporeality that they thought anchored even the very highest of human lives in an actively material world."²⁵

Sympathetic Movement

This question of materiality is an interesting and oft-unexplored angle from which to approach Leonardo. While the artist was an

affirmed Catholic and never explicitly challenged the religious tenets of his time, his notebooks reveal a heterogeneous mixture of thoughts and suppositions about the material and metaphysical substances of the world. Given the porous nature of his interdisciplinary thinking, these writings are a rich resource with which to study the artistic and philosophical location of his automata, particularly in contrast with later Cartesian treatises concerning minds, bodies and machines. Reading the two against one another, the scholastic and artistic production of Leonardo da Vinci reveals an intriguing alternative to the problematic disembodiment of Enlightenment rationality.

As an anatomist, Leonardo developed unique and inventive theories about the interconnections between the body and soul. As Descartes would later suggest, Leonardo's description of nervous tissue also proposes a network in which one's spirit inhabits the body.²⁶ This spirit, however, is a particular, interlinking intermediary between the soul and the body that is scarcely present in Descartes. Leonardo notes:

The spirit of sentient animals moves through the limbs of their bodies and when the muscles it has entered are responsive it causes them to swell, and as they swell they shorten and in shortening they pull the tendons that are joined to them. *Consequently material movement springs from the spiritual.* [emphasis added].²⁷

Spirit, defined in his writings as "power united to a body,"²⁸ is thus on a different order of embodied importance than Descartes "animal spirits." The latter, which the philosopher assumes are generated in the heart, travel to the brain, and then propagate to the nerves and muscles, appear to have a fleeting and transitory lifecycle.²⁹ Leonardo's spirits, common to all sentient creatures, are not generated and routed from within the body, but rather infuse and animate its materiality with far less ontological remove from the mind and soul.

These anatomical and metaphysical suggestions also affect Leonardo's consideration of represented bodies in art. In his treatise on painting, Leonardo advises his audience on the central importance of depicting the movement of a figure, thereby illustrating the movement of their spirit. Expertly captured motion thereby represented the "intention of his [subject's] mind" whereas the still

figure omitted this crucial aspect of portraiture.³⁰ In this Renaissance attitude towards art, the material painting thereby gained liveliness when the empathic movements of the subject's spirit could be copied and transmitted into the eye of the beholder. Movement and spirit were animating, slipping across forms and materials to create sympathetic responses between viewers and artworks. This primacy of spiritual movement is also echoed in Leonardo's antecedent art theorist Leon Battista Alberti, who suggests, "the *istoria* will move the soul of the beholder when each man painted there clearly shows the movement of his own soul."³¹

This slip between souls and spirits is further clarified in Leonardo's anatomical studies, wherein he situates the soul within the body's "sensus communis" or "common sense": a joining point of all the five senses that he theorized to exist just behind the optic foramina of the eye.³² There the soul presided in a "seat of judgement" like a captain of a ship, arbitrating the direction and flow of the spirit, yet deeply immersed in the sensory world of the body. In this sense, the eyes really were the windows to the soul, and vision really could move a viewer's spirit. This location is a far remove from Descartes own unique answer to the problem of pinpointing the site of the soul in the brain. His candidate of the pineal gland accords with the logic of his model—the organ is centrally located next to the major arteries of the brain and thus better able to coordinate the flow of animal spirits—yet this location greatly distances the soul (and therefore the spiritual) from sensation and movement.³³

Unlike Descartes's machinic model, Leonardo's body was intimately partnered with its soul, and yet, critically, it also was not reducible to or moldable by it, as Neo-Platonic theories might otherwise suggest. In an intellectual climate that presumed a degree of isomorphism between physical beauty and morality or virtue, Leonardo da Vinci is somewhat unique in his rejection of these early physiognomic principles.³⁴ Instead, the artist maintained that the shaping of the body only occurred on its own terms, through the repeated and duration wear of its material movements. Of the face, he notes:

The face shows some indications of the nature of men, their vices and their complexions; in the face the marks which separate the cheeks from the lips, the nostrils from the nose, and the sockets from the eyes, show

clearly whether these are cheerful men, often laughing; and those who show few such indications are men who engage in thought; and those, the planes of whose features are in great reliefs and hollows are bestial and angry men, of little reason; and those who have very clearly marked lines between the eyebrows are irascible; and those who have horizontal lines marked on their foreheads are men full of concealed or public lamentations; and similar things can be said of many parts of the face.³⁵

These lines and reliefs are wrinkles: the animated material traces of the movements of the spirit through the body.

What's more, this enlivened materiality does not seem to be limited to humans, and indeed, Leonardo's writings and sketches make frequent links across species, arguing for continuities between the different bodies of animals. A proposed, but unrealized treatise would concern the movement of all four-legged animals (including humans, which, as Leonardo notes, also crawl on both hands and feet when they are infants).³⁶ From the Windsor folios, sheet RL 12012 v

features a study of the facial anatomy of muscle groups corresponding to different emotional states. In a note, Leonardo comments that the same muscle groups that govern expressions of anger are at work in both humans and horses.³⁷ This is later illustrated in RL 1236 (fig. 3), which features sketches of men, horses and lions yelling angrily. The three animals are arranged in a vertical line and in profile, as if to better allow for heightened analogous comparisons. Intriguingly, the curl of the lower jaw of the lion bleeds into the swoop of the human's hair. At this level of material study, there is no human exceptionalism to be found.³⁸



Figure 3. Leonardo da Vinci, detail from RL 12012 v. *Yelling faces of Horse, Lion and Man*. Royal Collection Trust / © Her Majesty Queen Elizabeth II 2014.

The expressive qualities of animals and plants were also explored in the numerous riddles and allegories Leonardo wrote and collected. Part of the painter and inventor's social activities for a life in court, these stories are predicated upon a sympathetic identification with the emotions and mental processes of non-human life. "The Privet and the Blackbird," for example, is a criticism of self-centered individuals told through a domineering bird

and the berry bush it attacks and taunts.³⁹ The bird receives his comeuppance when the bush is used in its capture and imprisonment, suggesting that the subordinate elements of a system are not without their value and agency.

More explicitly, Leonardo's empathy with non-human animals found its material expression in his eating habits. In a rare example of Renaissance animal rights, this Renaissance vegetarian condemned meat-eaters as needlessly destructive, saying unto omnivores, "thou hast tried to make a sepulchre for all animals."⁴⁰ Sustenance, he maintained, could more righteously be found through plant foods and their infinite combinations. Whereas Descartes expresses no qualms that man should be the master over animals, Leonardo saw pronounced emotional and material links between human and non-human animals that morally prohibited such acts of domination and sovereignty.

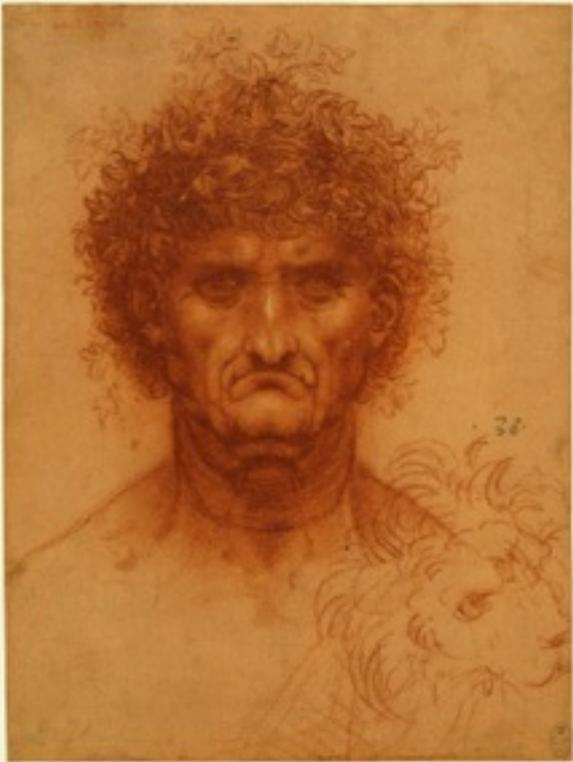


Figure 4. Leonardo da Vinci, RL 12502 v. *The Leonine Man*. Royal Collection Trust / © Her Majesty Queen Elizabeth II 2014

This cross-species identification is imaginatively continued in Leonardo's approach to the creation of chimeral creatures. In order to make new and fantastical animals "appear natural," Leonardo suggests that the discerning artist should swap or combine parts of different beasts, thereby creating imaginary figures that maintained a material realism.⁴¹ This practice is echoed throughout Leonardo da Vinci's sketches, and even finds its way into some of his more whimsical character portraits. *The Leonine Man* (fig. 4), for example, features pronounced and downcast jowls and a wild mane, which echoes those of the lion pelt he wears around his shoulders.⁴² His curled hair also resembles a metamorphosis into ivy leaves, bringing together man, animal and plant.

This substitution ethic transcends both animal and botanical anatomy and can be found in his approach to mechanics. Similar to his creature analogies, RL 19136-9v (fig. 5) visually juxtaposes the muscular movements of the leg and foot with that of a pulley while the page's notes describe the principles of simple machines

used to lighten loads. Leonardo expressly sought to glorify the esteem of mechanics, saying of this branch of science, it “is the noblest and useful above all others, since by means of it all animated bodies which have movement perform their actions.”⁴³ A proposed plan for a book on mechanical principles was to consist firstly of their theoretical elements followed by their application within the bodies of men and animals. After all, he claims, “nature cannot give the power of movement to animals without mechanical instruments.”⁴⁴ This claim was soon applied in the inventor's prototypes for a flying machine. By studying the mechanical principles by which birds moved through the air, Leonardo sought to create an artificial body that would achieve the same principles of movement. This was possible in the inventor's mind because:

a bird is an instrument working according to the mathematical law, which instrument it is in the capacity of man to reproduce... We may therefore say that such an instrument constructed by man is lacking nothing except the life of the bird, and this life must needs be imitated by the life of man, [sic].⁴⁵

As cultural historian Jonathan Sawday notes, rather than focusing on a contemporary calculus of power-to-weight ratios, this model of engineering is predicated upon an ethos of substitution: “‘fusing’ two ‘machines’ so that they have become one: an Ovidian fantasy of the transformation has become reality.”⁴⁶

This imagined porosity between machinic and organic bodies was also present in the wider intellectual and artistic community of Leonardo's historical surrounds. Leonardo's forerunner Alberti suggests in his *Ten Books of Architecture* that:

all engines may be looked upon to be a sort of Animals, with prodigious strong hands... they move Weights in the same Manner as we Men do with our Arms.... the same Distention and Contraction of the Members and Nerves, which we use in pulling, thrusting or lifting, we are to imitate in our Engines [sic].⁴⁷

The later engineer Augustino Ramelli, following closely on Leonardo's designs,⁴⁸ illustrated his treatise of mechanical systems in a cut-away style, mimicking the language of popular anatomy books.⁴⁹ These great machine bodies lead Sawday to suggest that by the fifteenth-century the divide between the natural and the artificial was quite effaced.⁵⁰

This point is further driven home in Cesare Ripa's 1603 iconological portrait of Artifice, which describes the embodied concept as follows:

He is nobly clothed because Art is *noble* of itself. His Hand upon the screw shews that *Engines* have been contriv'd by *Industry*; that by them incredible Things like the perpetual Motion have been *perform'd*. The Hive declares the *Industry* of the *Bees*, which, being very inconsiderable, are nevertheless *great* as to their conduct [sic, emphasis original].⁵¹

The accompanying illustration (fig. 6), attributed to Giovanni Guerra, depicts Artifice as a conduit between mechanic and insectile industries. One hand rests upon an Archimedes screw while the other is greeted by a phalanx of bees.⁵² The latter hand doesn't quite touch the hive and the figure's head is drawn looking towards this interaction with an astonished expression. The relation between the man and the insects thus suggests more of a mutual exchange than that of domination and subordination. With a depiction of the artificial that is equal parts organic, mechanical and artistic, such an account situates the possibility of biomechanics on amazing, but not fundamentally upsetting, terms.

Key to this intellectual climate of cross-species and cyborgic identifications is the Italian Renaissance's unique understanding of invention, which finds its root in the word *ingenium*. Rather than seeking to create entirely new artifacts in a detached space of artificiality, a genius inventor would seek instead to find novel arrangements between objects and principles, quite irrespective of their origins.⁵³ Like the irrational relationships between curios in a cabinet of curiosity or the chimerical creatures described by Leonardo, *ingenium* proposed

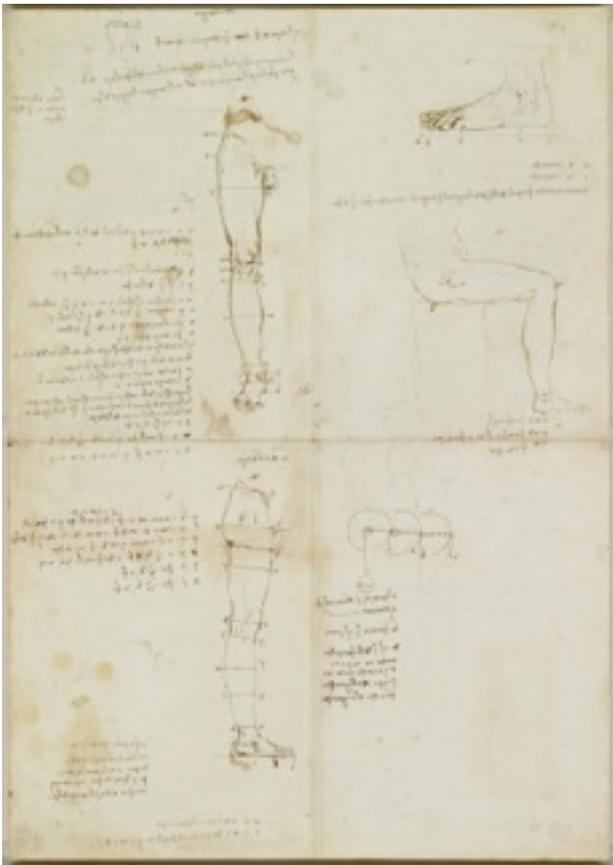


Figure 5. Leonardo da Vinci, RL 19136-9v. Proportions of the leg and a system of pulleys. Royal Collection Trust / © Her Majesty Queen Elizabeth II 2014

a model of the imagination that was fixed to the free flow of principles evinced by material objects, while never being quite beholden to their prescribed categories of analysis. Rather than being the product of domination and control over nature on the part of a human inventor, *ingenium* instead inspired an ethos of adaptability, timeliness, and an acute responsiveness to the systems in which the inventor was imbricated.⁵⁴ In his study of the term, philosopher Timothy D. Harfield concludes, “[o]f all the concepts in the Humanist repertoire, *ingenium* is the most powerful, not only because of the central place it appears to occupy in the rhetorical mode of thought, but also its ability to demonstrate the possibility of a non-anthropocentric humanism.”⁵⁵



Figure 6. Attributed to Giovanni Guerra, "Artifice," In Cesare Ripa's *Iconologia*, Rome 1603.

Conflicting Humanism

This reading of the Italian Renaissance and its humanist worldview provides a strong point of contrast against the typical narrative of secular rationality inherent to the previously mentioned historians of technology and a wider body of post-Enlightenment humanist scholars and reformers. Indeed, the speculative roboticist

Marc Elling Rosheim is keen to place Leonardo da Vinci's knight in a position of human exceptionalism and glory. Suggesting that the robot was likely placed in Sforza Castle's *Sala delle Asse*, a domed room, which featured an intricate fresco of trees painted by Leonardo himself, Rosheim concludes that this juxtaposition of natural and artificial imagery enthroned the knight in a position of supremacy. The roboticist notes, "[i]n his humanist philosophy, man was the microcosm: the universe writ small. Leonardo's Knight, when viewed in a man-made microcosm such as the *Sala delle Asse*, would have embodied the Renaissance ideal of 'man as the measure,' the standard for which the world was designed."⁵⁶

The exact definition of humanism and its (variable) historical location; however, is a point of scholarly debate. As Tony Davies's survey of the many humanisms across Western history attests, the word's meaning is muddled at best.⁵⁷ Humanism was originally an educational term referring to a curricular program emphasizing Greek and Latin texts. This phenomenon started during the Italian Renaissance but didn't coalesce into a formal discipline or term until the nineteenth-century educational reforms of Friedrich Immanuel Niethammer.⁵⁸ By this point the valences of the word were far removed from Renaissance concerns, though subsequent thinkers were happy to mobilize this pedigree for the benefit of their contemporary and political sympathies. To Carl Jacob Christoph Burckhardt, Renaissance humanism could be characterized by a new species of free-determining, secular thinkers, whereas the Comte de Gobineau found inspiration therein for his proto-Nietzschean (and extremely racist) views.⁵⁹ These forms of humanism, "demonstrably shaped by and inseparable from nineteenth-century conditions and concerns," provided a vital narrative of human triumph and righteousness in the face of the chaos and brutality of a nascent modernity.⁶⁰ Critically, however, these meanings largely failed to account for the interests and perspectives of Renaissance thinkers in and of themselves.

Modernity's humanism more recently has come under severe critique by anti-humanist and post-humanist thinkers seeking to expose and ameliorate a system of dangerous philosophical precepts inherent to its core values from the nineteenth to the twenty-first century. Thinkers such as Martin Heidegger and Donna Haraway have attacked humanism's underlying essentialist metaphysics—Heidegger

for the assumption of ontological givenness and Haraway for the gendered Cartesian dualism of a humanism predicated on the separation of the human from natural and artificial categories.⁶¹ To ameliorate the situation, these thinkers propose forms of ontological performativity and cyborgic intermingling, respectfully. By attending to the responsiveness of human imbrication in material environments and by embracing an ethos of transformation and inter-corporeal substitution, these interventions stand to re-integrate the human into the material world, thus transforming what it means to be human.

That these critiques share much in common with the material play of Leonardo's Renaissance has escaped the vast majority of post-human and anti-humanist thinkers. Harfield, for instance, laments the perceived oversight on the part of radically-oriented post-humanist thinkers who would endorse the wholesale rejection of the humanist tradition in favor of articulating human worldviews radically anew. This intellectual demolition, he argues, risks repeating Enlightenment ahistoricism while also ignoring any potentially helpful alternative foundations scattered throughout history.

Renaissance humanism—which is to say, a study of how Renaissance thinkers conceived of the human in relation to its larger material and metaphysical environment—is thus still an understudied and underrepresented topic. However, within its boundaries and in the work and writing of Leonardo da Vinci, one such foundation may yet exist. *Ingenium* and the anti-essentialist, empathetic orientation between the artist, animals and his technological surrounds suggests a spirit of movement between types and modes of being that exceeds even Heidegger or Haraway's imagination.

Aligned with contemporary new materialist sympathies, this particular form of humanism troubles the metaphysical exceptionalism of Descartes by fostering a spirit of conviviality between objects and species. Through an emotive and sensory imbrication in the world, human animals are deeply situated in a material frame that moves between a variety of animate and inanimate forms. Similar to Timothy Morton's concept of "ecological thinking," the work of Leonardo da Vinci and his peers propose a perspective of nature that is far from external to the human, but in fact constitutes and dissolves this very division.⁶²

The Moving Horizon

What, then, are we to make of the spectacularly animated body of Leonardo's knight? Rather than the specter of a robotic malefactor rising up against its human master, the perspective expressed by Leonardo and his cultural surrounds suggests a rather more material and far less calamitous reading.

Part technological (and perhaps part animal if the supposition of its ghoulish face proves true), Leonardo's knight engages in a play of passing as human, affecting a Renaissance Turing test (or, more to the point, a pop quiz). It is one that the device is designed to fail—the confusion between human and artifice is momentary and arresting, but ultimately gives way to jest. Antipodal to the typical Kantian mode of detached spectatorship, the work forcefully incites an emotional and bodily reaction that cannot be sustained. In the fallout of the ruse, however, are the conditions for an insightful (and perhaps even pleasurable) fellow-feeling.

The fragmentary nature of the object makes it difficult to faithfully reconstitute the possible experience of its use. Instead, one can speculatively imagine the encounter through a phenomenological and material lens: let us then conceive of a young gentleman walking through the Sforza palace, perhaps lost in thought. Suddenly, he is confronted by an empty suit of armor that leaps upwards out of the corner of his eye. Its cold, steel arms snap around the man's body, freezing him in his steps. His pulse quickens, perhaps he shrieks as the knight's helmet snaps open, holding his face up against its own gruesomely-rendered visage.⁶³ And then, after the man's death fails to materialize, he bursts out laughing at the reassurance of his safety and marvels at the artifice of the illusion. The Medusa-egsue face, rather than turning the man to stone, has enlivened the inanimate body of the robot. In the arms of a machine, the spectator notes the similarity between his joints and those of the knight that holds him. Peeking through the cracks of its armor, the intimacy of its embrace allows him to catch glimpses of the cords, pulleys and gears that holds the figure upright. In order to exit, he will need to touch it in turn, pushing against its arms to ease its grip. The robot's body has a gentle resistance that reminds him of the muscles and tendons of his own. Departing from the robot, he moves his weight off the pressure plate on the floor that triggered the knight, causing it to collapse downwards again. It seems strangely lifeless now- its movement and

spirit are absent without his empathetic participation.

This imagined vignette hints at the possible interactions between viewer and artifice, suggesting a mode of interacting with art that is dramatically different from the contemplative study of the art historian or connoisseur. The laughter, chemical release of endorphins and physical arrest of this hypothetical spectator would intervene in his emotional, bodily and conceptual horizons, threatening to destabilize the solidity of anything remotely resembling a rational viewer. Its mode of engagement is neither discursive nor iconological, further confounding traditional art historical hermeneutics. Of the nascent theories of the moving image, it is also somewhat at odds. This movement is without the vertiginous psyche of Georges Didi-Huberman (for that would reinstate an anthropocentrism back into the ground so recently cleared by the robot's sweeping arms)⁶⁴ and further resists the traumatic nature of horror suggested by Maria H. Loh (its ruse is rather more playful and easily defeated).⁶⁵ Instead, the robot seems poised to work on much larger stakes, suggesting a mode of analysis that exists at the intersection of the histories of art, science and philosophy. Movement, not only of images but also of physical principles, biological forms and material horizons, animates human and non-human bodies, bringing forth the possibility of sympathetic alignments and *ingenium*.

Contrary to the Cartesian inheritance still writ into humanist and post-humanist accounts of materiality, Leonardo da Vinci and his historical peers suggest an alternative means of understanding and activating the environmental milieu. Movement and empathetic connections between bodies have the potential to enliven matter in a mode that is less deconstructive than it is radically collectivist. In this flat ecology of bodies, machines and spirit, Leonardo's robot can thus be seen as more than the forbearer of a modernity whose industry and inhumanity fed both the appetites of Enlightenment technologists and the fears of post-Enlightenment deriders of automata. Instead, the knight might contain the very means by which to undo this operation.

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Endnotes

- ¹ René Descartes, as quoted in Anne Friedberg, *The Virtual Window: From Alberti to Microsoft* (Cambridge and London: MIT Press, 2006), 52.
- ² Dalia Judovitz, *The Culture of the Body: Genealogies of Modernity* (Ann Arbor: University of Michigan Press, 2001), 67.
- ³ René Descartes, *Discourse on Method of Rightly Conducting the Reason and Seeking the Truth in the Sciences*, originally published in Harvard Classics, vol. 34, part 1 (New York: P.F. Collier & Son, 1909-14), reprinted online at <http://www.bartleby.com/34/1/> (2001), accessed 15 April 2013.
- ⁴ Ibid.
- ⁵ Scott Maisano, "Infinite Gesture: Automata and the Emotions in Descartes and Shakespeare," in *Genesis Redux: Essays in the History and Philosophy of Artificial Life*, ed. Jessica Riskin (Chicago: University of Chicago Press, 2007), 71.
- ⁶ Leonardo da Vinci, as quoted in Martin Kemp, *The Human Animal in Western Science* (Chicago: University of Chicago Press, 2007), 106.
- ⁷ Silvio A. Bedini, "The Role of Automata in the History of Technology," *Technology and Culture* 5, no 1 (Winter 1964): 42.
- ⁸ Derek de Solla Price, "Automata and the Origins of Mechanism and Mechanistic Philosophy," *Technology and Culture* 5, no 1 (Winter 1964): 10, 23.

⁹ Ibid., 23.

¹⁰ Ibid.

¹¹ Alexander Marr, "Gentile curiosité: Wonder-working and the culture of automata in the Late Renaissance," in *Curiosity and Wonder from the Renaissance to the Enlightenment*, ed. R.J.W. Evans and Alexander Marr (Aldershot, England: Ashgate, 2006), 150-156. Marr, however, does not address early Renaissance perspectives at length, and presents this late Renaissance turn as a departure from a seemingly continuous derision towards automata dating back to antiquity. This article, though brief and narrow in focus, attempts to trouble this assumption. Looking to the two centuries before Marr's study it is evident that automata apologetics were neither as necessary nor as relevant to the epistemology concerns of the early Renaissance as his scholarship would suggest.

¹² Simon Schaffer, "Enlightened Automata," in *The Sciences of Enlightened Europe*, ed. William Clark, Jan Golinski and Simon Schaffer, (Chicago: University of Chicago Press, 1999), 127.

¹³ Ibid., 128.

¹⁴ Ibid., 149; 158.

¹⁵ Mark Elling Rosheim, *Leonardo's Lost Robots* (Würzburg, Germany: Springer, 2006), 70-113.

¹⁶ Carlo Pedretti, as quoted in Rosheim, *Leonardo's Lost Robots*, ix. This claim could be contested, however, by a similarly speculative look at Giovanni de la Fontana's *Bellicorum instrumentorum* (c. 1420) with its spectacular Fire Witch and mechanized devil.

¹⁷ Rosheim, *Leonardo's Lost Robots*, 69.

¹⁸ Ibid.

¹⁹ Genevieve Warwick, "Speaking Statues: Bernini's *Apollo and Daphne* at the Villa Borghese," *Art History* vol. 27, no. 3 (June 2004): 354.

²⁰ Warwick suggests the *Borghese Hermaphroditus* may have formed one such trap, whereby the gendered ambiguity of the work is hidden and then revealed in the processes of circumlocution, thereby soliciting surprise and embarrassment. Ibid., 361.

²¹ Ibid., 375.

²² Jessica Riskin, "Machines in the Garden," *Republic of Letters: A Journal for the Study of Knowledge, Politics and the Arts* vol. 1, no. 2 (April 30, 2010): 31-32.

²³ Ibid., 32.

²⁴ Ibid., 41.

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- ²⁵ Ibid., 43.
- ²⁶ Descartes, *Discourse on Method*, Part V, np. The similarities between Descartes and Leonardo's interests in anatomy and machines are noted briefly in Martin Kemp, *Leonardo*, 2nd ed. (New York and Oxford: Oxford University Press, 2011): 128-9. The (arguably more important) dissimilarities, however, are not addressed.
- ²⁷ Leonardo da Vinci, *Notebooks*, ed. Irma A. Richter, Thereza Wells and Martin Kemp (Oxford and New York: Oxford University Press, 2008), 59.
- ²⁸ Ibid., 47.
- ²⁹ Descartes, *Discourse*, Part V, np. It should be noted, however, that the centrality of the heart and its heat in his anatomical model strikingly parallels the role of putrescence and fermentation in Paracelus' alchemical research into the creation of homunculi. This strange continuity is somewhat at odds with the rational empiricism of Descartes and contradicts William Harvey's pump model (upon which the rest of Descartes anatomical theories are based). This may be another early Renaissance survival, deserving further study. For more on Paracelus and early modern homunculi, see Kevin LaGrandeur, "Do Medieval and Renaissance Androids Presage the Posthuman?" *CLCWeb: Comparative Literature and Culture*, vol 12, no. 3 (September 2010): article 3.
- ³⁰ Leonardo da Vinci, as quoted in Martin Clayton, *Leonardo da Vinci: The Divine and the Grotesque* (London: The Royal Collection), 116.
- ³¹ Leon Battista Alberti, as quoted in Jonathan Golberg, "Quattrocento Dematerialization: Some Paradoxes in a Conceptual Art," *The Journal of Aesthetics and Art Criticism*, 35, No. 2 (Winter, 1976): 158.
- ³² Clayton, *Leonardo da Vinci: The Divine and the Grotesque*, 32.
- ³³ Gert-Jan C. Lokhorst and Timo T. Kaitaro, "The Originality of Descartes' Theory About the Pineal Gland," *Journal for the History of Neurosciences*, 10, no. 1 (2001): 6-18.
- ³⁴ Clayton, *The Divine and the Grotesque*, 64.
- ³⁵ Ibid, 13.
- ³⁶ Martin Kemp, *The Human Animal in Western Art and Science*, (Chicago: University of Chicago Press, 2007), 90.

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- ³⁷ Clayton makes a critical distinction between Leonardo's horse and human studies, suggesting that Leonardo's pursuit of harmonious proportion vexed the study of the latter, whereas the former remained unburdened from such idealizations due to its lack of humanist importance. This claim seems poorly verified in the artist's studies, in which the subject of the horse conforms to a highly rigorous measurement and standardization that strikes me as very continuous with his treatment of human forms. Moreover, sheets such as RL 1012 v further problematize this claim by situating both subjects on a shared plain of representation and study. Clayton, *The Divine and the Grotesque*, 25.
- ³⁸ For a mirrored account of this ecological interpretation of the human, see the following section of the Codex Leicester: "The earth has a vegetative soul in that its flesh is the soil, its bones are the arrangements of the connections of rocks of which the mountains are composed, its cartilage is the tufa, and its blood is the water in the veins; the lake of blood that is throughout the heart is the oceanic sea, and its breathing is the increase and decrease of the blood during its pulsing, just as the sea is the flow and ebb of the water; and the heart of the soul of the world is the fire that is infused throughout the earth, and the seat of the vegetative spirit is in the fires, which in various locations in the world breathe through baths and mines of sulphur and in [volcanoes]," as quoted in Kemp, *Leonardo*, 131.
- ³⁹ Leonardo, *Notebooks*, 220.
- ⁴⁰ *Ibid.*, 348.
- ⁴¹ Kemp, *The Human Animal*, 43.
- ⁴² Leonardo da Vinci scholarship seems unable to place or account for this oddity. Martin Kemp suggests that it may form a rare exception to Leonardo's otherwise total disengagement with physiognomic looking practices, whereas Clayton first dismisses the pelt as an afterthought, and then suggests that it may be linked to the association of lions with choleric humours. Both of these statements seem to be contradicted by the artist's own writings on the relationship between temperament and the body. See Kemp, *The Human Animal*, 43 and Clayton, *The Divine and the Grotesque*, 64.
- ⁴³ Leonardo, as quoted in Jonathan Sawday, "Forms Such as Never Were in Nature," in *At the Borders of the Human: Beasts, Bodies, and Natural Philosophy in the Early Modern Period*, ed. Erica Fudge, Ruth Gilbert and Susan Wiseman (New York: St. Martin's Press, 1999), 183.
- ⁴⁴ Leonardo, *Notebooks*, 54.

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- ⁴⁵ Leonardo, as quoted in Sawday, "Forms Such as Never Were," 184.
- ⁴⁶ Ibid.
- ⁴⁷ Alberti, as quoted in Jonathan Sawday, *Engines of the Imagination: Renaissance Culture and the Rise of the Machine*, (New York, Routledge, 2007), 109.
- ⁴⁸ Ladislao Reti, "Leonardo and Ramelli," *Technology and Culture* 14, no. 4 (Oct. 1972): 577-605.
- ⁴⁹ Sawday, *Engines of the Imagination*, 178.
- ⁵⁰ Sawday, "Forms Such as Never Were in Nature," 181.
- ⁵¹ Cesare Ripa, *Iconologia*, trans. Pierce Tempest (London: B. Motte, 1709), 7.
- ⁵² For more on the attribution of Ripa's artist, see Stefano Pierguidi, "Giovanni Guerra and the Illustrations to Ripa's *Iconologia*," *Journal of the Warburg and Courtauld Institutes*, 61, (1998): 158-175.
- ⁵³ Timothy D. Harfield, "Exposing Humanism: Prudence, *Ingenium*, and the Politics of the Post Humanism," *Journal of Historiographical Sociology*, DOI: 10.1111/johs.12001 (2012): 23.
- ⁵⁴ Ibid., 22.
- ⁵⁵ Ibid.
- ⁵⁶ Rosheim, *Leonardo's Lost Robots*, 71.
- ⁵⁷ Tony Davies, *Humanism (London and New York: Routledge, 2008)*, 3.
- ⁵⁸ Ibid., 9.
- ⁵⁹ Ibid., 10-17.
- ⁶⁰ Ibid., 18-19.
- ⁶¹ Martin Heidegger, *Being and Time* [1927], trans. John MacQuarrie and Edward Robinson (New York: Harper Perennial, 2008), 42, and Donna Haraway, "The Cyborg Manifesto," in *The Feminism and Visual Culture Reader*, ed. Amelia Jones (New York: Routledge, 2010), 589.
- ⁶² Timothy Morton, *Ecology Without Nature* (London and Cambridge: Harvard University Press, 2007), 9.
- ⁶³ Here one can recall the painter's famous Medusa and the playful opposition of effects between its namesake and the Pygmalion action of the automata.
- ⁶⁴ Georges Didi-Huberman, "Foreword," in *Aby Warburg and the Image in Motion* (New York: Zone Books, 2004), 13.
- ⁶⁵ Maria H. Loh, "Introduction: Early Modern Horror," *Oxford Art Journal* 34, no. 3 (2011): 399.

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