

# Machines in the Garden

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What does it mean to be alive and conscious: an aware, thinking creature? Using lifelike machines to discuss animation and consciousness is a major cultural preoccupation of the early twenty-first century; but few realize that this practice stretches back to the middle of the seventeenth century, and that actual lifelike machines, which peopled the landscape of late Medieval and Early Modern Europe, shaped this philosophical tradition from its inception. By the early 1630s, when René Descartes argued that animals and humans, apart from their capacity to reason, were automata, European towns and villages were positively humming with mechanical vitality, and mechanical images of living creatures had been ubiquitous for several centuries. Descartes and other seventeenth-century mechanists were therefore able to invoke a plethora of animal- and human-like machines. These machines fell into two main categories: the great many devices to be found in churches and cathedrals, and the automatic hydraulic amusements on the grounds of palaces and wealthy estates.

Neither category of contraptions signified, in the first instance, what machine metaphors for living creatures later came to signify: passivity, rigidity, regularity, constraint, rote behavior, soullessness. Rather, the machines that informed the emergence of the Early Modern notion of the human-machine held a strikingly unfamiliar array of cultural and philosophical implications, notably the tendencies to act unexpectedly, playfully, willfully, surprisingly, and responsively. Moreover, neither the idea nor the ubiquitous images of human-machinery ran counter to Christian practice or doctrine. Quite the contrary: not only did automata appear first and most commonly in churches and cathedrals, the idea as well as the technology of human-machinery was indigenously Catholic. The church was a primary sponsor of the literature that accompanied the technology of lifelike machines, and the body-machine was also a recurrent motif in Scholastic writing.<sup>1</sup>

Automata were therefore theologically and culturally familiar, things with which one could be on easy terms. They were funny, sometimes bawdy, and they were everywhere. To understand what Descartes and other seventeenth-century mechanists did with the idea of animal and human machinery, one needs to take into account its familiarity and pre-existing meanings. From the early to mid-seventeenth century, at the hands of mechanist philosophers, matter and its mechanical combinations would be divested first of soul and then of life. This essay tours a mechanical culture that flourished before that development, in which machines represented precisely the capacities that the mechanists would later deny them: divinity and vitality.

### DEUS QUA MACHINA

A mechanical Christ on a crucifix, known as the Rood of Grace, drew great flocks of pilgrims to Boxley Abbey in Kent during the fifteenth century. This Jesus, which operated at Easter and the Ascension, “was made to move the eyes and lipps by stringes of haire.”<sup>2</sup> Moreover, the Rood was able

to bow down and lifte up it selfe, to shake and stirre the handes and feete, to nod the head, to rolle the eies, to wag the chaps, to bende the browes, and finally to represent to the eie, both the proper motion of each member of the body, and also a lively, expresse, and significant shew of a well contented or displeased minde: byting the lippe, and gathering a frowning, forward, and disdainful face, when it would pretend offence: and shewing a most milde, amiable, and smyling cheere and countenance, when it woulde seeme to be well pleased.<sup>3</sup>

Even before approaching the Rood for benediction, one had to undergo a test of purity administered by a remote-controlled saint:

Sainct Rumwald was the picture of a pretie Boy saint of stone . . . of it selfe short, and not seeming to be heavie: but for as much as it was wrought out of a great and weightie stone . . . it was hardly to be lifted by the handes of the strongest man. Neverthelesse (such was the conveighance) by the helpe of an engine fixed to the backe thereof, it was easily prised up with the foote of him that was the keeper, and therefore, of no moment at all in the handes of such as had offered frankly: and contrariwise, by the meane of a pinne, running into a post . . . it was, to such as offered faintly, so fast and unmoveable, that no force of hande might once stirre it.<sup>4</sup>

Having proven your “cleane life and innocencie” at the hands of the rigged Saint Rumwald, you could proceed to the mechanized Jesus. Automaton Christs—muttering, blinking, grimacing on the cross—were especially popular.<sup>5</sup> One, a sixteenth-century Breton Jesus, rolled his eyes and moved his lips while blood flowed from a wound in his side. At his feet, the Virgin and three attendant women gesticulated, while at the top of the Cross, a head symbolizing the Trinity glanced shiftily from side to side.<sup>6</sup>

Mechanical devils were also rife. Poised in sacristies, they made horrible faces, howled and stuck out their tongues to instill fear in the hearts of sinners. The Satan-machines rolled their eyes and flailed their arms and wings; some even had moveable horns and crowns.<sup>7</sup> A muscular, crank-operated devil with sharply pointed ears and wild eyes remains in residence at the Castello Sforzesco in Milan.<sup>8</sup>

There were also automaton angels. A host of these, in one Florentine festival, carried the soul of Saint Cecilia up to heaven.<sup>9</sup> For the feast of the Annunciation at San Felice, the fifteenth-century Florentine architect Filippo Brunelleschi sent the archangel Gabriel in the reverse direction in a mechanical “mandorla,” an almond-shaped symbol in which two merging circles represent heaven and earth, matter and spirit. Brunelleschi, a master of holy mechanics (*ingegni*), mechanized heaven too. His mechanical paradise was “truly marvellous . . . for on high a Heaven full of living and moving figures could be seen as well as countless lights, flashing on and off like lightning.”<sup>10</sup>

Brunelleschi was outdone in the second half of the century by Cecca (Francesco D’Angelo), who engineered Christ’s Ascension at the Church of Santa Maria del Carmine. Here, where Christ was borne aloft on “a Mount very well made of wood” the “said Heaven was somewhat larger than that of S. Felice in Piazza.” Moreover, the festival planners added a second heaven over the chief tribune, with “certain great wheels” that “moved in most beautiful order ten circles standing for the ten Heavens.” These were filled with stars: little copper lamps suspended from pivots so that they would remain upright as the heavens turned. Two angels stood on a platform suspended from pulleys.

These angels, when a little rope was unwound from the Heaven above, came down the two larger ropes . . . and announced to Christ that He was to ascend into Heaven, and performed their other functions. And since the iron to which they were bound by the girdle was fixed to the platform on which they stood, in such a way that they could turn round and round, they could make obeisance and turn about both when they had come forth and when they were returning . . . ; wherefore in reascending they turned towards the Heaven.<sup>11</sup>

The heavenly machinery was balanced beneath by engineered hells. The Passion play at Valenciennes in 1547 featured a hell with a “great mouth” specially rigged for “opening and closing when needed.”<sup>12</sup> Another mechanical inferno’s moving gates gaped ajar amid rumbling thunder and flashes of lightning to spew forth writhing automaton serpents and dragons.<sup>13</sup>

A menagerie of mechanical beasts played in religious theater, especially the mammoth mystery plays. A mechanical bear menaced David’s sheep,<sup>14</sup> Daniel’s lions gnashed their teeth,<sup>15</sup> and more lions knelt before Saint Denis.<sup>16</sup> Balaam’s ass balked and swerved before the angel of the Lord.<sup>17</sup> The serpent twined itself round the trunk of the Tree of Knowledge to proffer its apple to Eve.<sup>18</sup> A wild boar tracked by hunters, a leopard that sniffed Saint André, a dromedary that

wagged its head, moved its lips and stuck out its tongue, a host of dog- and wolf-shaped devils surging up from the underworld, and serpents and dragons spewing flames from their mouths, noses, eyes and ears rewarded the stunningly devoted spectators at the forty-day performance of the *Mystère des actes des apôtres* in Bourges in 1537.<sup>19</sup> The machines were commissioned from local artisans, usually clockmakers.<sup>20</sup>

Mechanical enactments of biblical events spread across the European landscape, reaching a crescendo during the late fifteenth and early sixteenth centuries.<sup>21</sup> Nor was the holy machinery the sole province of the cities. In May 1501, an engineer in the village of Rabastens, near Toulouse, was engaged to build an endless screw that could propel the Assumption of the Virgin. The following August, the Virgin rose heavenward, attended by rotating angels, and disappeared into paradise (its entrance hidden in clouds). Meanwhile a golden, flaming sun also rotated, carrying more angels on its rays.<sup>22</sup> Another mechanical Ascension of the Virgin took place annually in Toulouse, moving in alternate years between the *Église Notre-Dame de la Daurade* and the *Église Saint-Etienne*.<sup>23</sup> At home, in the region around Toulouse, children built small replicas of the Virgin-elevator for the Assumption in the same way that they arranged crèches at Christmas.<sup>24</sup>

Even the Eternal Father appeared in mechanical reenactments. In Dieppe, for example, he loomed at the top of the *Église Saint-Jacques*, a “venerable old man” astride a cloud in an azure, star-sprinkled canopy of heaven. Mechanical angels flew about him, flapping their wings and swinging their censers. Some played the “Ave Maria” in time to the organ on handbells and horns at the end of each office. After the service, the angels blew out the altar candles.<sup>25</sup> At the feast of Whitsuntide, the Holy Ghost, in the form of a white dove, flew down from the main vault of Saint Paul’s Cathedral in London, breathing a “most pleasant Perfume” over the congregation.<sup>26</sup>

Most Early Modern mechanical figures were found in cathedrals and exhibited religious themes. Many were connected with clocks, outgrowths of the church’s drive to improve time-keeping for the better prediction of feast days,<sup>27</sup> or with organs. A mechanical man gripping a mallet to ring the hour became a familiar sight on clocktowers across Europe in the mid-fourteenth century. He went by the name “Jack” in England; in Flanders, he was “Jean”; in France, “Jaquemart”; and in Germany, “Hans.”<sup>28</sup> Over the next century, Jack-Jean-Jaquemart-Hans acquired crowds of company. On the clock in the Piazza San Marco in Venice, beginning in 1499, two giant shepherds struck the hour while an angel playing a horn emerged, followed by the three Magi. The Magi bowed before the Virgin and Child and removed the crowns from their heads with one hand while using the other to extend their gifts. They then stood, replaced their crowns, and exited through a door that opened automatically.<sup>29</sup> The scene of the Magi was a common motif on church clocks, which also often included calendars indicating feast days; the positions, oppositions, and conjunctions of the stars; the signs of

the zodiac; the phases of the moon; and, as in the San Marco clock, astronomical models of a Ptolemaic cosmos.<sup>30</sup>

There were also roosters: mechanical cocks crowed and flapped their wings on clocks across Europe from about the mid-fourteenth century.<sup>31</sup> Perhaps the earliest, built around 1340, performed on the hour at Cluny Abbey, near Macon. Meanwhile an angel opened a door to bow before the Virgin, a white dove representing the Holy Spirit flew down from above and was blessed by the Eternal Father, and fantastic creatures emerged to stick out their tongues and roll their eyes before retreating inside the clock.<sup>32</sup> Another rooster did its flapping and crowing on the town clock in Niort from about 1570. This bird presided over three separate scenes involving some forty figures. Care appeared in a window to exhort Servitude to come out and strike the hour. An automaton Gabriel enacted the Annunciation with a mechanical Mary, Holy Ghost, and Eternal Father. Finally, a mechanical choir of angels sang in time to their conductor's baton, while Saint Peter appeared from behind a door, looked about, opened another door, and, at the admonition of two children, disappeared back into his own chamber to make way for the twelve apostles. These arrived holding hammers with which they rang the hour while the children nodded their heads in time. The clock had a false door with two automaton Hercules on either side, ready to drop their clubs on anyone who tried to enter; above them, Vulcan with his hammer also stood guard.<sup>33</sup>

The Cluny, Niort, and other roosters were outdone by one unrivaled among mechanical fowl, the renowned rooster of Strasbourg Cathedral. For nearly five centuries, the Strasbourg rooster cocked its head, flapped its wings, and crowed on the hour atop the Clock of the Three Kings, originally built between 1352 and 1354, and refurbished by the clockmaker brothers Isaac and Josias Habrecht between 1540 and 1574. Beneath the rooster, the astrolabe turned and the Magi scene played out its familiar sequence. In the Habrecht version, the rooster, Magi, Virgin, and Child were joined by a host of other automata: a rotation of Roman gods who indicated the day of the week; an angel who raised her wand as the hour was rung, and another who turned her hour-glass on the quarter-hour; a baby, a youth, a soldier, and an old man representing the four stages of life, who rang the quarter-hours; and above them, a timid, mechanical Christ, who came forth after the old man finished ringing the final quarter-hour, but then retreated in haste to make way for Death to strike the hour with a bone.<sup>34</sup> In a similarly dark scene at the Frauenkirche in Munich, from 1514, a vengeful God brandished a sword hourly over fallen mankind; Christ and Mary, begging for clemency, made him lower it to the crowing of the ever-present rooster.<sup>35</sup>

Apart from church clocks, the other prime spot for mechanical figures was church organs.<sup>36</sup> Organ-driven mechanical angels came in whole choirs of bustling figures, including the conductor waving a baton, sometimes accompanied by flocks of singing birds. Automaton angels lifted horns to their mouths and played

drums and carillons.<sup>37</sup> At the cathedral in Beauvais, Saint Peter towered atop an organ of the late fourteenth or early fifteenth century and blessed the congregation on his feast day by nodding his head and moving his eyes.<sup>38</sup> Strasbourg Cathedral was hectic with mechanical activity, having automata connected with its organ as well as its clock. Three moving figures, known as Rohraffen, were attached to the strings of the organ in the late fifteenth century (where they remain): Samson boldly opening and closing the jaws of a lion; the *Héraut de la ville*, lifting his trumpet to his lips; and the *Bretzelmann* in a red and black cape.

The *Bretzelmann*, still in place, has long hair and a shaggy beard, an aquiline nose and an evil look. When set in motion, he seems to speak with great emphasis, opening and shutting his mouth while shaking his head and gesticulating with his right arm.<sup>39</sup> At Pentecost, throughout the service, the *Bretzelmann* mocked the priest, laughing, hurling insults and coarse jokes, and singing nasty songs:

By disordered movements, profane and improper canticles shouted at the top of his lungs, he disturbs the hymns of the arriving pilgrims and covers them with ridicule. In this manner, he turns the devotion of the visitors into distraction, their pious sighs into laughs, but he also troubles the priests who chant the holy office, and he is the cause of an abominable and execrable perturbation during the sacrifice of the holy mass.<sup>40</sup>

Other organs sported disembodied heads that frowned, contorted their faces, rolled their eyes, stuck out their tongues and opened and closed their mouths as the music played. A colossal automaton head animated the church organ in Neustadt-an-der-Harth in Bavaria, and others were to be found across Germany and the Low Countries from the fifteenth century.<sup>41</sup> From the organ gallery of the cathedral in Barcelona, the head of a moor hung by its turban. It made mild facial expressions when the music played softly; when the strains grew louder, it rolled its eyes and grimaced as though in pain.<sup>42</sup> And in the Cloître des Augustins in Montoire, in the Loire Valley, a mechanical head on the organ gallery gnashed its teeth with a noisy clatter.<sup>43</sup>

Early Modern Europe, then, was alive with mechanical beings, and the Catholic Church was their main patron. The church was also a primary sponsor, between the late fifteenth and late sixteenth centuries, of the translation and printing of a small flood of ancient texts on mechanical and hydraulic automata, which then informed the construction of such devices throughout the Renaissance. For example, the first printed edition of Vitruvius's *De Architectura*—containing descriptions of the third century B.C. engineer Ctesibius's water organ and other automata—appeared in 1486 as a key part of the Renaissance popes' project to build a Christian Rome.<sup>44</sup>

To be sure, automata also appeared in secular settings: on town halls, municipal clock towers,<sup>45</sup> and the grounds of noble estates. Early Modern engineers mechanized purely political icons as well as religious ones. A very early example is the

clock that Charles IV commissioned for the Frauenkirche in Nuremberg to commemorate his Golden Bull, which established the constitutional structure of the Holy Roman Empire and set the number of electors at seven. On the clock, which was inaugurated in 1361, seven figures known collectively as the *Männleinlaufen* (parade of little men) emerge at noon to bow before the emperor.<sup>46</sup> Another legendary instance was the automaton lion built by Leonardo da Vinci in 1515 for a banquet hosted by Florentine merchants in Lyon in honor of Francis I: “wherefore Leonardo being asked to devise some bizarre thing, made a lion which walked several steps and then opened its breast, showing it full of lilies.”<sup>47</sup> The lion represented Lyon and the lilies the French throne.

Clockwork automata, often exhibiting secular themes, were the playthings of princes—especially the Holy Roman emperors—from the late fifteenth century. Hans Bullmann of Nuremberg built android musicians, for which Ferdinand I summoned him to Vienna.<sup>48</sup> Henry VIII, according to a 1542 inventory, had an automaton clock at Westminster.<sup>49</sup> Hans Schlottheim, a clockmaker in Augsburg, designed automaton-embellished utensil holders to sit on banquet tables. These were wrought in gold, silver, or brass, typically in the form of a ship. One, which Schlottheim made for Rudolph II around 1580 and is now at the British Museum, has figures moving around a sundial and passing before a throne. Schlottheim also devised two automaton crayfish—one crept forward and the other backward—that were bought by the Prince Elector of Saxony in 1587.<sup>50</sup>

Noble houses hummed and whirred with clock-automata that were miniaturizations of the ones in churches and, indeed, designed by the same people. For example, the Habrecht brothers, who renovated the Strasbourg Cathedral clock in the mid-sixteenth century, also did a brisk business in household automaton clocks.<sup>51</sup> Automata figured too in lay theater.<sup>52</sup> In 1547, John Dee, the future magus and court philosopher to Queen Elizabeth I, but then a nineteen-year-old reader in Greek at Trinity College, Cambridge, built what seems to have been a mechanical flying dung beetle for an undergraduate production of Aristophanes’s *Pax*. At the point in the play when Trygaeus, determined to reach Jupiter’s Olympian palace, leaps onto his unlovely Pegasus and exhorts it to fly, Dee’s artificial insect took to the air, inspiring “a great wondring, and many vaine reportes spread abroad of the meanes how that was effected.”<sup>53</sup>

But automata were first and most extensively to be found in churches and cathedrals. Indeed, even before the clock and organ automata, as early as the mid-thirteenth century, the sketchbook of Villard de Honnecourt included rope-and-pulley controlled mechanisms, one for a mechanical angel that turned to point its finger at the sun and another for a mechanical eagle, the caption to which reads: “How to make the eagle face the Deacon while the Gospel is being read.”<sup>54</sup> Later, automaton Christs, angels, devils, and Virgins prepared the ground for mechanical animals of every variety and clockwork models of the cosmos itself. The Catholic Church was the cradle of the clockwork universe and its mechanical inhabitants.

In the interest of calendar reform and of accurate predictions of feast days, the church sponsored both the astronomy and the technology of timekeeping.<sup>55</sup> And the church also promulgated, in association with clockwork, the plurality of Early Modern mechanical images of people and animals.

A Franciscan monk of iron and linden-wood built around 1560 and attributed to a man named Juanelo Turriano offers a final example of the Early Modern mechanization of faith.<sup>56</sup> Turriano's life is a tale in itself. Clockmaker, architect, and engineer to the Holy Roman Emperor Charles V, and then to his son and heir, King Philip II of Spain, Turriano went into retreat with Charles, after his abdication in 1556, at the monastery of Yuste, near Plasencia.<sup>57</sup> There, the imperial clockmaker built automata to comfort the gouty ex-emperor: an automaton lady who danced and played a tambourine, a flight of wooden sparrows that fluttered and "flew about the room as if alive," a miniature army of prancing horses, and soldiers playing diminutive trumpets.<sup>58</sup> According to legend, Philip II asked Turriano to build the automaton after Philip's son, Don Carlos, made a miraculous recovery following a head injury. A fifteenth-century Franciscan monk, Diego de Alcalá, whose relics were brought to the prince's bed at the moment of crisis, received credit for the cure, and the king, to express his eternal gratitude, asked Turriano to build the mechanical monk.

The monk, wearing a tunic, cowl, and sandals, and with its mechanism hidden beneath its habit, is a fully self-contained device, sixteen inches high. It clutches a crucifix and rosary in its left hand. Elizabeth King, the monk's eloquent biographer, describes its performance thus:

Slowly the monk comes to life. He turns his head to single out one among the company. Left foot stepping forth from under the cassock hem, then right foot, the monk advances in the direction of his gaze, raising the crucifix and rosary before him as he walks. His eyes move: turning his head, he looks to the raised cross and back to his subject. His mouth opens, then closes, affording a glimpse of teeth and interior. He bends his right arm and with the gathered fingers of his hand he strikes his breast. The small blow is audible. And now he is lowering and turning his head as he walks: the elbow and shoulder in synchronized motion he brings the cross higher, up to his lips, and kisses it. Thirty seconds into the act, he's taken eight steps, beat his chest three times, kissed the cross, and traveled a distance of twenty inches. At what seems like the last moment—for doubtless the subject of his attention has backed away from the table's edge—he looks away, arms still aloft, executes a turn to his right, and makes a new appointment. He will make seven such turns and advances in his campaign if the mainspring has been fully wound. The uninterrupted repetition corresponds exactly to a trance-like performance of prayer, incantation.<sup>59</sup>

Just over a foot in height and weighing five pounds, the monk is somehow formidable. Perhaps even more than his contemporaries—the muttering Christs, the horn-playing angels, the eye-rolling devils, the teeth-chattering heads—he

embodies the power of an image, the peculiar power of a moving image,<sup>60</sup> and the extraordinary sway of a moving, devotional image.

Mechanization is often taken as an index of modernization. But automaton icons had a Medieval impetus in a tradition of imagery in which the tangible, visible, earthly representations of Christian lore and doctrine were pushed ever farther.<sup>61</sup> The icons were representations in motion, inspirited statues: they were mechanical and divine. Rolling their eyes, moving their lips, gesturing, and grimacing, these automata dramatized the intimate, corporeal relation between representation and divinity, icon and saint. As this relation became increasingly fraught, the machinery took on new meanings. Reformism and clockmaking developed side by side from Augsburg to Strasbourg to Geneva. The flood of mechanized religious images coincided both in time and, most importantly, in place with the heating-up of the questions of whether and how religious images blurred the boundary between image and deity.

The Reformation cast a partial hush over the humming, groaning, chirping, whistling, chattering ecclesiastical machinery. The uncouth *Bretzelmann* of Strasbourg Cathedral was silenced along with many of his fellow organ-automata and, indeed, with many of the church organs themselves, which became emblematic of Catholic ritual.<sup>62</sup> Henry VIII, in establishing the Anglican Church, banned mechanical statues from English churches.<sup>63</sup> The grimacing Rood of Boxley Abbey gave its last performance in 1538, after being snatched from Boxley by Geoffrey Chamber as part of his commissioned defacement of the abbey. Chamber wrote to Thomas Cromwell that he had found in the Rood

certain engines and old wire, with old rotten sticks in the back, which caused the eyes to move and stir in the head thereof, “like unto a lively thing,” and also, “the nether lip likewise to move as though it should speak,” which was not a little strange to him and others present.<sup>64</sup>

But can it have been any surprise that the Rood was made of wood and wire? It and its many cousins had been built by local artisans—clockmakers, carpenters—and treated by its local beholders with great familiarity, inspiring, by the accounts of contemporary chroniclers, at least as much laughter as awe. The *Bretzelmann* of Strasbourg Cathedral was obviously funny. Similarly, in the case of the lever-and-pulley-operated Saint Rumwald, “many times it mooved more laughter than devotion, to beholde a great lubber to lifte at that in vaine, which a young boy (or wench) had easily taken up before him.”<sup>65</sup>

That mechanical icons were mechanical cannot have been big news. But Chamber and his fellow iconoclasts introduced the idea that such icons were deceptions by virtue of being mechanical. Machinery, that is, could not represent divinity other than deceitfully. One could not know a thing to be mechanical and simultaneously believe it to be divine. The destruction of mechanized icons represented only small swells inside the larger surges of iconoclasm that spread across Europe

during the middle decades of the sixteenth century.<sup>66</sup> But the demolition of the Rood and its ilk reveals that one core logic of iconoclasm—the rigorous distinction between the divine and the artifactual—brought with it a fundamentally transformed view of the ontology of machines.

The abbot and monks, when Chamber questioned them, predictably denied any knowledge of the mechanical Rood.<sup>67</sup> But it had inspired great devotion in the people of Kent, as well as pilgrimages from across the realm,<sup>68</sup> so Chamber deemed it an immediate danger and promptly removed it to Maidstone. There he displayed it in the public market and instilled in the townspeople a “wondrous detestation and hatred [of the Rood] so that if the monastery had to be defaced again they would pluck it down or burn it.”<sup>69</sup> The chronicler Charles Wriothesley described the events as follows:

Allso the sayde roode was sett in the market place first at Maydstone, and there shewed openlye to the people the craft of movinge the eyes and lipps, that all the people there might see the illusion that had bene used in the sayde image by the monckes of the saide plaace of manye yeares tyme out of mynde, whereby they had gotten great riches in deceivinge the people thinckinge that the sayde image had so moved by the power of God, which now playnlye appeared to the contrarye.<sup>70</sup>

The Rood was then transported to London where John Hilsey, bishop of Rochester, exhibited it during a sermon at Saint Paul’s Cross, after which it was torn apart and burned before a crowd of duly admonished onlookers.<sup>71</sup> Again, Wriothesley recorded the occasion:

This yeare, the 24th daie of Februarie, beinge the Soundaie of Sexagesima and the Saint Mathias daie, the image of the roode that was at the Abbey of Bexley, in Kent, called the Roode of Grace, was brought to Poules Crosse, and their, at the sermon made by the Bishopp of Rochester, the abuses of the . . . engines, used in old tyme in the said image, was declared, which image was made of paper and cloutes from the legges upward; ech legges and armes were of timber; and so the people had bene eluded and caused to doe great adolatrie by the said image.<sup>72</sup>

Three decades later, the lawyer and historian William Lambarde gave a caustic account of the Rood and “the Monkes, which were in love with the Picture.” Of the Rood, Lambarde wrote sarcastically, “it needed not Prometheus fire to make it a lively man, but onely the helpe of the covetous Priestes of Bell, or the aide of some craftie College of Monkes.” As for the Rood’s colleague, Saint Rumwald, Lambarde revealed it to have been operated by “a religious impostor standing out of sight.” He recalled Cromwell’s triumph over the monks and their machines: “But what? I shall not neede to reporte, howe lewdly these Monkes, to their own enriching and the spoile of Gods people, abused this wooden God . . . because a good sort be yet on live that sawe the fraude openly detected at Paules Cross.”<sup>73</sup>

As with other Reformist initiatives, both sides of the confessional divide participated in this partial rejection of mechanized religious images. By the mid-sev-

enteenth century, certain Catholic monarchs had developed a distaste for automaton angels and mechanical Ascensions. In 1647, Louis XIV and the Queen Mother came to view the automaton angels of Dieppe and found them not to their liking; that was the end of the angels.<sup>74</sup> An interdiction of 1666 put an end to the Virgin's annual mechanical Ascension in Toulouse on the grounds that it distracted the congregation and caused "irreverent reflections."<sup>75</sup>

Still, mechanized devotional objects did not disappear; on the contrary, they survived and flourished. Thus, during the late sixteenth and seventeenth centuries, the proliferating and elaborating machines coexisted with proliferating and elaborating theological and philosophical suspicions of them. The Council of Trent, in its 1563 decree on the use of sacred images, placed a ban on "unusual" images except when they were approved by a bishop.<sup>76</sup> Rather than eliminating mechanical icons, this ban helped to motivate a thematic shift. For example, in the wake of the Council's decree on images, the three-dimensional nativity scene (*presepio*) rose to prominence in Catholic settings as an acceptable representation of the divinity and an answer to the Lutheran Christmas tree. The Jesuits embraced the *presepio* and made it their own, in large part by mechanizing it. Within a few decades, a fad for mechanical and talking *presepi* was in full swing in aristocratic and wealthy bourgeois homes as well as in churches. The sixteenth-century architect Bernardo Buontalenti built a clockwork *presepio* for his pupil, Francesco, son of Cosimo de' Medici, with opening and closing heavens, flying angels, and figures walking toward the manger. And Schlottheim built an elaborate mechanical *crèche* around 1589 for the Court of Saxony. The *crèche*, which is now in the Museum für Sächsische Volkskunst in Dresden, includes shepherds and kings proceeding past the manger while angels fly down from heaven; Joseph rocks the cradle, as an ox and ass rise up to stand before the holy Infant.<sup>77</sup>

A prominent representative of the Jesuitical love of mechanical devotional images was the polymath Athanasius Kircher, who served as a major fulcrum of philosophical activity during the middle decades of the seventeenth century. Among many other devices, Kircher designed a hydraulic machine to represent the Resurrection of the Savior and another device "to exhibit Christ walking on water, and bringing help to Peter who is gradually sinking, by a magnetic trick." In this contraption, the operative features were a strong magnet placed in Peter's chest and the steel out of which were wrought Christ's outstretched hands "or any part of his toga turned toward Peter." The two figures, propped on corks in a basin of water, would then be drawn inexorably together: "the iron hands of Christ soon feel the magnetic power diffused from the breast of Peter . . . The artifice will be greater if the statue of Christ is flexible in its middle, for in this way it will bend itself, to the great admiration and piety of the spectators."<sup>78</sup>

More generally, as historians of religion have often noted, the Jesuits made clockwork automata a principal tool in their promulgation of Christianity. They arrived before a succession of Chinese emperors bearing gifts of automata.

One such offering, dispatched in 1618 by Nicholas Trigault, the Jesuit ambassador of the Chinese Mission, was an elaborate mechanized nativity scene. The works were fully internal and spring-driven. As Trigault described it, the scene included the three Magi giving homage with bows, the Holy Virgin responding with gracious gestures, Joseph rocking the cradle where the Holy Child lay, an ass and an ox thrusting their heads toward the cradle, the Holy Father making a benediction, two angels continuously ascending and descending, and even moving shepherds.<sup>79</sup> The Jesuits included worldly themes as well as religious ones in their automatic offerings. The Jesuit priest Gabriel de Magalhaens, who arrived in China in 1640, presented to the Emperor Kang'hi a spring-driven android knight that marched about with a drawn sword for a quarter of an hour.<sup>80</sup> The Jesuits spread explicitly Christian automata as well as secular ones with missionary purposes around the world.

Secular automata proliferated alongside religious ones. Many of the same clockmakers and engineers who designed religious automata for churches also built secular ones for private patrons or public settings. In the clockmaking region of southern Germany during the late sixteenth and early seventeenth centuries, mechanical animals like Schlottheim's mechanical crayfish became popular: automaton spiders; Neptune astride a creeping bronze tortoise; a life-sized bear, wearing real fur and beating on a drum.<sup>81</sup> In the 1680s and 1690s, clockmakers began to fabricate animated paintings (*tableaux mécaniques*) depicting hunting parties and other rustic scenes.<sup>82</sup>

Waterworks on the grounds of estates constituted the main secular tradition in automata. The wealthy and powerful found in lifelike machinery an endless source of comedy, and of the most bawdily uproarious, knee-slapping variety. The first part of this article has traced the predominantly Christian origins of androids and other mechanical creatures and described an early intimacy between machinery and divinity. The second part takes up the relation of machinery to the vitality represented by a remarkably vivacious vulgarity. From the sublime, onward to the ridiculous.

## WATERWORKS

Over a period of several centuries, spraying their unsuspecting guests with water automatically and other mechanized acts of hospitable abuse was a favorite pastime of Italian, French, and German aristocrats.<sup>83</sup> "Frolicsome engines" (*engiens d'esbattement*)<sup>84</sup> were to be found as early as the late thirteenth century at the chateau of Hesdin (in present-day Pas-de-Calais), seat of the *comtes d'Artois*. The machines are mentioned, beginning in 1299, in the account books of Robert II (Robert the Noble), *comte d'Artois*. The following year, the family appointed a castle "Master of Engines" (*Maistre des engiens du chastel*). After that, the *engiens* make regular appearances in the accounts, continuing through the reign of

Robert II's successor, Mathilde (known as Mahaut), *comtesse d'Artois*. From these entries, we gather that the engines included mechanical monkeys with real (regularly replaced) skins,<sup>85</sup> monkeys which, after 1312, sported horns.<sup>86</sup> There were also "an elephant and a he-goat"<sup>87</sup> and a machine referred to as "the boar's head."<sup>88</sup> From 1419 until his death in 1467, the *comtesse* Mahaut's descendant, Philippe le Bon, Duke of Burgundy, conducted a thorough refurbishment of the stock he had been left by his forebears and expanded it considerably. His own account books contain a meticulous catalog of the many mechanized tricks he inflicted on visitors. These included

painting of 3 personages that spout water and wet people at will . . . a machine for wetting ladies when they step on it . . . an "*engien*" which, when its knobs are touched, strikes in the face those who are underneath and covers them with black or white . . . another machine by which all who pass through will be struck and beaten by sound cuffs on their head and shoulders . . . a wooden hermit who speaks to people who come to that room . . . 6 personages more than there were before, which wet people in various ways . . . eight pipes for wetting ladies from below and three pipes by which, when people stop in front of them, they are all whitened and covered with flour . . . a window where, when people wish to open it, a personage in front of it wets people and closes the window again in spite of them . . . a lectern on which there is a book of ballades, and, when they try to read it, people are all covered with black, and, as soon as they look inside, they are all wet with water . . . [a] mirror where people are sent to look at themselves when they are besmirched, and, when they look into it, they are once more all covered with flour, and all whitened . . . a personage of wood that appears above a bench in the middle of the gallery and fools [people] and speaks by a trick and cries out on behalf of Monsieur le Duc that everyone should go out of the gallery, and those who go because of that summons will be beaten by tall personages dressed like "sots" and "sottes," who will apply the rods afore-said, or they will have to fall into the water at the entrance to the bridge, and those who do not want to leave will be so wetted that they will not know where to go to escape from the water . . . a window in which there is a box suspended in the air, and on that box there is an owl which makes various faces in looking at people and gives an answer to everything that one wishes to ask it, and its voice can be heard in that box . . .<sup>89</sup>

The Hesdin *engiens desbattement*, in all their malicious glory, achieved great notoriety and inspired many imitations in the following century.<sup>90</sup>

By 1580 and 1581, when Montaigne was traveling through Europe, hydraulic automata had grown so commonplace in noble palaces and on the grounds of bourgeois estates that he grew bored with them. Outside Augsburg, at the summer place of the rich banking family Fuggers, Montaigne saw sprays of water from "little brass jets which cannot be seen," activated by concealed springs. "While the ladies are busy watching the fish play, you have only to release some spring: immediately all these jets spurt out thin, hard streams of water to the height of a man's head, and fill the petticoats and thighs of the ladies with this coolness." Elsewhere, hidden jets could be triggered to gush directly into the face of a visitor who

stopped to admire a particular fountain.<sup>91</sup> In one room, the Fuggers palace also had an automaton lion that sprang forward when a door was opened.<sup>92</sup>

At Pratolino, a palace of Francesco I de' Medici, Grand Duke of Tuscany, Montaigne marveled at Buontalenti's elaborate installations. In one "miraculous" grotto he saw

not only music and harmony made by the movement of the water, but also a movement of several statues and doors with various actions, caused by the water; several animals that plunge in to drink; and things like that. At one single movement the whole grotto is full of water, and all the seats squirt water on your buttocks; and if you flee from the grotto and climb the castle stairs and anyone takes pleasure in this sport, there come out of every other step of the stairs, right up to the top of the house, a thousand jets of water that give you a bath.<sup>93</sup>

The grotto at Pratolino also had singing birds and an automaton lady who emerged from behind a door to fill a cup with water.<sup>94</sup> Another of the Grand Duke's residences boasted a grotto bustling with hydraulically driven "water mills and windmills, little church bells, soldiers of the guard, animals, hunts, and a thousand such things."<sup>95</sup>

Montaigne was unimpressed even by the already famous Villa d'Este in Tivoli. The Tivoli palace and gardens had been built during the 1550s and 1560s by Cardinal Ippolito II d'Este, then Governor of Tivoli, as consolation after an unsuccessful campaign to win the papacy. Completed in 1572, the grottoes were already old news, and Montaigne, arriving in 1580, declined to write a lengthy description of them since there were already "published books and pictures on the subject." Moreover, the "gushing of an infinity of jets of water checked and launched by a single spring that can be worked from far off, I had seen elsewhere on my trip." He then provided a jaded, if meticulous, account of the water organ:

The music of the organ, which is real music and a natural organ, though always playing the same thing, is effected by means of the water, which falls with great violence into a round arched cave and agitates the air that is in there and forces it, in order to get out, to go through the pipes of the organ and supply it with wind. Another stream of water, driving a wheel with certain teeth on it, causes the organ keyboard to be struck in a certain order; so you hear an imitation of the sound of trumpets. In another place you hear the song of birds, which are little bronze flutes . . . this by an artifice like that of the organ; and then by other springs they set in motion an owl, which, appearing at the top of the rock, makes this harmony cease instantly, for the birds are frightened by his presence; and then he leaves the place to them again. This goes on alternately as long as you want. . . . All these inventions, or similar ones, produced by the same natural causes, I have seen elsewhere.<sup>96</sup>

Twenty years after Montaigne's travels, when Henri IV decided his palaces needed embellishment, he lured away Tommaso Francini, engineer to Ferdinando

I de' Medici, then Grand Duke of Tuscany, to supply the requisite waterworks. Francini began at Saint-Germain-en-Laye, where he mechanized a small throng of classical gods and heroes and other moving figures all in bronze.<sup>97</sup>

There were grottoes devoted to Neptune, Mercury, Orpheus, Hercules, Bacchus, Perseus, and Andromeda. John Evelyn visited the palace at Saint-Germain-en-Laye in 1644 and recorded in his diary what he had seen there.<sup>98</sup> He and other visitors described an automaton Neptune with a streaming blue beard, brandishing his trident, naked astride a chariot pulled by seahorses, accompanied by three round-bellied, horn-playing tritons. Farriers, “their faces black with filth and sweat,” hammered iron on an anvil and—“that which is most pleasant and seems made to provoke laughter”—drenched their eager audiences with surprise sprays of water. Mercury posed by a window with one foot carelessly propped, “loudly intoning a trumpet.” Elsewhere, Orpheus played his lyre for an audience of animals and trees who, including the trees, stretched and craned toward him.<sup>99</sup> A towering Perseus descended upon a mighty dragon arising from beneath the waves. Perseus swung his sword to behead the fearsome beast, sending it, slain, back down into the watery depths; whereupon farther back in the grotto, Andromeda promptly lost her chains. Meanwhile busy figures of artisans—blacksmiths, weavers, millers, carpenters, knife-grinders, fishermen—went about their sundry tasks.<sup>100</sup>

Another dragon appeared in the Dragon Grotto, shaking its terrible head and wings while belching steam. This Dragon, despite its ferocity, was surrounded by “various little birds, which really one would say were not painted & counterfeit, but living and fluttering their wings, which make the air resound with a thousand sorts of song; and above all the Nightingales there vie to make music in several choirs.” There were cuckoos, too, and in yet another grotto, a nymph played at an organ.<sup>101</sup> The Grotto of Torches—a subterranean chamber lit only by flames—displayed a heady sequence of scenes “by force of water”: first, an idyllic, island-dotted sea in which fishes and sea-monsters sported happily beneath a rising sun; then, a violent storm, thunder and lightning, wrecked ships heaved up on shore. Next came a calm and fertile vista, a flowerbed in bloom and trees filled with fruit. In the distance, the king and his family strolled, all except the dauphin, who arrived from on high in a chariot carried by two angels. The angels crowned the prince with a glittering coronet. Finally, there was a desolate landscape, a desert littered with ruins where reptiles, insects, and other wild creatures crawled about. At the last, a fairy emerged playing a flute and the animals gathered round to listen.<sup>102</sup>

What was it like to live amidst such machines, to be familiar with them, to have them shape one's earliest intuitions about machinery: how it works, what it does, how it compares to living creatures? We can form a reasonable impression thanks to a meticulous daily record of the life of a child who grew up with the hydraulic grottoes of Saint-Germain-en-Laye in his garden. The record includes every passing fancy, every lisping pronouncement, the menu at each meal down to the numbers of prunes or grapes consumed and careful descriptions of all bowel

movements. The child was the future Louis XIII, the son of Henri IV and Maria de' Medici, born just when Francini was working on his father's fountains. The dauphin's birth was recorded by his doctor and caretaker, Jean Hérouard, on September 27, 1601, as having taken place at "ten-thirty and a half quarter according to my watch made in Abbeville by M. Plantard."<sup>103</sup> The prince would spend his childhood mostly at Saint-Germain-en-Laye where he developed a passion for mechanical things.

As a toddler, the dauphin watched the workers from his windows<sup>104</sup> and, from the age of three, in the spring of 1605, he began visiting the grottoes several times each week.<sup>105</sup> Hérouard's diary describes him in bed one morning instructing a chambermaid, "Pretend dat I am Ofus [Orpheus] and you are da fontaineer [fontaineer], you sing da canaries."<sup>106</sup> Soon afterward, he was working the grotto faucets, spraying himself and everyone else with water.<sup>107</sup> The prince plagued Francini with visits to his workshop, demanding the name of each instrument and explanations of how they worked.<sup>108</sup> At home, he talked continuously about Francini and pretended to be Francini, making wax models, working the fountains, collecting his pay. He played fountains in bed, in his gilt washbasin, and under the dining table—"fssss" and "dss"—making believe he was spraying people with water. On one occasion, he was rebuked by a nurse for climbing under the table to play fountains to the neglect of a visiting dignitary.<sup>109</sup> Francini built a small wooden fountain for the dauphin, which was installed near his rooms on his fourth birthday.<sup>110</sup> While work on the fountain was underway, the prince went continually to the workshop to see it, begging, "let's go see my fountain at Francino's place."<sup>111</sup>

At first, the dauphin could not be persuaded to enter the Orpheus grotto. Finally his governess, Madame de Montglat, enticed him in with a handful of sugared peas, having first covered the figure of Orpheus with a drape. Thereafter, the prince boasted that he had been to the very back of the grotto and was not afraid even to touch Orpheus himself.<sup>112</sup> In addition to occasional notes of fear, the passion also contained more than a hint of childish eroticism. Hérouard dutifully recorded on one occasion: "says he has a faucet in his ass and another in his willie: 'fs fs.'" The future absolutist—who was given to exposing himself to the servants and whose "willie" was the focus of much teasing attention from all members of the household including the King and Queen—was especially fond of the willie-fountain joke, which he repeated frequently.<sup>113</sup>

The day the dauphin's governor, M. de Souvé (Gilles, marquis de Courtenevaux), arrived at Saint-Germain-en-Laye, shortly before the prince's seventh birthday, Louis insisted on taking the tired traveler on an immediate tour of the grottoes, where he worked the faucets himself.<sup>114</sup> As a child king, having ascended to the throne at age nine after his father's assassination, Louis XIII continued to visit Francini, going straight to his workshop upon arriving at the palace, and amusing himself for hours at a time by forging, soldering, and filing fountain pipes.<sup>115</sup>

Louis XIII liked clockwork as well as hydraulic automata. Hérouard's journal describes the dauphin, age four, beating his spoon against his plate and announcing to his governess: "Maman ga [Mme. de Montglat] I am ringing da hour dan, dan, it rings like da jackamart who beats on da anvil."<sup>116</sup> Here he is at six, shopping in Paris along the rue Saint Honoré, choosing a spring-driven toy carriage on offer for 15 écus.<sup>117</sup> Later in the same year, the dauphin was given a cabinet fabricated in Nuremberg with "a great number of personages doing diverse actions by the movement of sand." The personages enacted Christ's Passion and the taking of Jerusalem. The prince played fervently with the instrument, quickly grasping how to make it stop and go, demonstrating it to everyone in the palace, and discoursing about the works with mispronunciations that charmed his guardian: "*contrepès, pour countrepoids*."<sup>118</sup>

This intimacy with and predilection for mechanical games persisted through generations of French princes. Louis XIV was born at Saint-Germain-en-Laye and received mechanical toys—automaton clocks, a carriage and company of soldiers, a mechanical theater that enacted an opera in five acts—well into his dotage.<sup>119</sup> His son, Louis XIII's grandson, had an arsenal of automaton toys including another mechanical army of a hundred soldiers.<sup>120</sup>

You didn't need to be a king or a prince: the popes, too, competed in the game of hydraulic trickery. When Ippolito Aldobrandini became Pope Clement VIII in 1592, he assigned his nephew, Cardinal Pietro Aldobrandini, the task of building a villa of unprecedented magnificence. Aldobrandini engaged the hydraulic engineers Orazio Olivieri and Giovanni Guglielmi to design what Edith Wharton, on her tour of Italian villas, would describe as "the inevitable *théâtre d'eau*."<sup>121</sup> At the Villa Aldobrandini, the waterworks included a room of hydraulic and pneumatic marvels, the Stanza dei Venti (Room of Winds), which would draw visitors throughout the seventeenth and eighteenth centuries. Water from hidden, spring-triggered spouts, it should go without saying, leapt out to spray hapless visitors. Other spouts of water and water-powered jets of air played organ- and fife-music and produced eerie sounds—thunder, wind, rain, whistles, shrieks—while wooden globes danced magico-mechanically across the floor.<sup>122</sup>

The popes, their nephews and their grandnephews, all the little cardinals and archbishops wanted their own hydro-mechanical toys. Markus Sittikus von Hohenems, sovereign and archbishop of Salzburg from 1612 until his death in 1619, installed waterworks at his Schloss Hellbrunn that remain in operation almost four centuries later.<sup>123</sup> When he was elected archbishop, Sittikus was already a connoisseur of automata. He had lived briefly at the Villa Aldobrandini; moreover, his uncle, Cardinal Marco Sittico Altemps, nephew of Pope Pius IV, had built the Villa Mondragone, which had a renowned Water Theater designed by the engineer Giovanni Fontana.<sup>124</sup> In Sittikus's garden, visitors are still invited to seat themselves around a stone table, on stone benches with hidden spouts that release jets of water on command, drenching the obedient from below.

In the Neptune Grotto to which they proceed, dripping and uproarious, guests gape at the Germaul, a stone gargoyle that rolls its eyes menacingly and sticks out its tongue. Fleeing the Germaul, the visitors are again watered down from spring-triggered spouts concealed in the walls. Arriving remoistened in the Birdcall Grotto, they are surrounded by the hydraulically produced sound of chirping and twittering birds. Afterward, they are led along the Royal Way past five small grottoes, each housing a scene enacted by automata: a miller grinding his wheat; a potter working at his wheel; a scissors grinder and his wife sharpening blades on a wheel while their child plays at their feet; Perseus freeing Andromeda from the dragon; Apollo flaying Marsyas. Next, present-day visitors arrive at an elaborate water-driven Mechanical Theater displaying a town square populated by more than a hundred moving figures: carpenters, innkeepers, musicians, and other street performers, a barber giving a client a shave, a butcher slaughtering an ox, a farmer pushing an old woman in a wheelbarrow, a marching military guard, a dancing bear. The Mechanical Theater, completed in 1752, was the contribution of Archbishop Andreas Jakob Graf von Dietrichstein; it replaced an earlier hydraulically powered mechanical scene representing a forge.

At the time that Sittikus's waterworks were being installed, princes across the land were importing hydraulic engineers to install automata on their palace grounds; it was routinely one of their first acts as sovereign. The adolescent Palatine elector, Frederick, brought his hydraulic engineer along with his seventeen-year-old bride, Elizabeth, daughter of King James I. Elizabeth traveled to Heidelberg for her wedding in 1613 accompanied by Salomon De Caus, an engineer from northern France and Huguenot refugee at her father's court.<sup>125</sup> De Caus would remain at Heidelberg as Frederick's engineer until 1620 when the elector, then also king of Bohemia, would lose his crown to the Holy Roman Emperor Ferdinand II and have to flee with his family to The Hague. The brevity of Frederick's Bohemian reign, which lasted a single winter, earned him the nickname "Winter King." But De Caus had time to transform the palace gardens into yet another hydraulic wonderland.

The waterworks' creator described grottoes in which fabulous creatures performed magico-mechanical feats.<sup>126</sup> In one, water poured from the breasts of a woman in the middle of the cavern, and from the mouth of a fish held by a man seated beside her. The couple was serenaded by a Satyr playing a flute, and opposite him, by the Nymph Echo, softly repeating each phrase. In the Grotto of Orpheus, the minstrel played his cello, charming the beasts around him—leopard, ram, lion, boar, stag, sheep, rabbit, and snake—who danced in time to the music. The Grotto of Neptune contained the god of the sea himself and some attendant creatures—a pair of swimming horses whose reigns he gripped, a couple of wading nymphs playing horns, and a cherub astride two dolphins—

all turning in stately circles around a great Gothic rock upon which a siren held a jug spouting water.<sup>127</sup>

A burgeoning literature on automatic machinery informed and accompanied installations such as the Palatine gardens waterworks. This literature began, as we have seen, with a series of ancient texts on mechanical and hydraulic automata, principally, in addition to Vitruvius's Ten Books, the treatises of Hero of Alexandria, which were repeatedly translated and printed over the course of the sixteenth century.<sup>128</sup> In turn, these inspired modern works that borrowed extensively from the classical ones. An influential example is Agostino Ramelli's *Le diverse e artificiose machine* (1588), which contains a plan for an "ingenious and delightful" fountain of twittering birds, based closely on designs from Hero's *Pneumatica*. Within the fountain, a nest of compartments is joined by a network of siphons. The siphons are connected above, through pipes, to little figures of birds with flutes in them. As water descends through the fountain, the siphons begin to function, emptying certain compartments and filling others, forcing air up through the various pipes in turn. The air, as it comes out the tops of the pipes into the birds with their flutes, makes them flutter and trill.<sup>129</sup>

De Caus was the author of another such work, *Les raisons des forces mouvantes avec diverses machines tant utiles que plaisantes* (1615), which has trees full of automaton birds, including one in direct imitation of a design by Hero, just like the one Montaigne had noted at the Villa d'Este: the birds flutter and chirp while an owl turns slowly toward them. When the intimidating owl faces the birds, they fall silent, but as he turns away, they resume their ruckus.<sup>130</sup> De Caus's treatise also contains meticulous accounts of the mechanisms of hydraulic grottoes like those of the Palatine gardens. In one, Galatea rides astride a big seashell drawn by two dolphins. Behind her, a Cyclops has put his club aside to play on a flageolet, while sheep gambol about. The mechanism is made entirely of wood, driven by two waterwheels. These are put in motion by jets of water from two pipes that emerge from a common reservoir. The pipes have valves that open and close alternately by means of a system of counterpoises, so that the wheelwork turns one way and then the other as Galatea and her dolphins move back and forth across the scene. A third waterwheel, through a train of gear-wheels, drives a pinned barrel that is in turn connected with the keys of the flageolet.<sup>131</sup>

By the 1660s, when Evelyn was at work on his gardening manuals, he considered it a matter of course that an essential part of the business would be to instruct "our docill Gardiner, how he may himselfe make & contrive these wonderfull Automats, . . . which at present so celebrate the Gardens of the greatest Princes; . . . & many other famous Gardens of the most illustrious persons of the World." It was not just an added flourish but actually "necessary," Evelyn counseled, "in these Inventions, to give some motion to the living creatures . . . that they may the [better] imitate nature." The possibilities were legion:

We may . . . people our Rocks with Fowle, Conies, Capricornes, Goates [& rapitary beasts, with] Hermites, Satyres, [Masceras] Shepheards, [rustic workes river gods Antiqs etc] and with divers Machines or Mills made to move by the ingenious placing of wheels, painted & turned by some seacret pipes of waters; The Figures above named may be formed of Potters earth, well moulded and baked; but if the states must be larger, of stone or Mettal: By these motions, histories, [Andromedas] and sceanes may be represented.<sup>132</sup>

In addition to the elaborate networks of levers, wheels, gears, flowing fluids, and falling weights, the advent of organ-barrel programming helped in the building of complex systems of lifelike motions. Kircher—who designed and described many automata including an “automatic organ machine which utters the voices of animals and birds”—was the first to publish a systematic account of the camshaft in 1650.<sup>133</sup> But by then, pinned cylinders had already been in use for several decades.<sup>134</sup> One of the earliest known examples was in an organ clock presented by Queen Elizabeth to the Sultan of Turkey in 1599.<sup>135</sup>

During the first decades of the seventeenth century, the use of camshafts spread quickly. De Caus adopted them to organize the motions in his reproductions of Hero’s singing and fluttering birds.<sup>136</sup> The Augsburg clockmaker Achilles Langenbucher put the new technology to work in mechanical musical ensembles composed of many playerless instruments.<sup>137</sup> Evelyn included an extensive description of the camshaft (the “Phonotactic Cylinder”) in *Elysium Britannicum*.<sup>138</sup> His discussion included explicit instructions for making such a device, which, like the construction of automata more generally, he considered to be essential to the art of gardening:

A Cylinder may be fitted so as to move, take out, & change the Teeth at pleasure, to place other in their stead: and so new Composition may be applied; . . . For example of this: Divide a Cylinder into 24 Measures, each of these [full] divide againe into 8 equal spaces, as we noted for Quavers; you shall bore holes, at every point of these divisions; as being [furnished] with a greate number [of] Teeth (as the Printers box is with Letters) for all sorts of Notse, which may keepe in a divided Drawer somewhere about the Organ, you may insert a new Composition or Tunes at pleasure in your Cylinder which, the more large & ample it is, will be so much the better for our purpose.<sup>139</sup>

By means of a camshaft, a single flow of fluid could work myriad effects. Evelyn singled out, as most “expeditious” and “ingenious,” those waterworks that “onely with the [precipitation] of water alone produce wind sufficient for all our motions.”<sup>140</sup> A single “Artificiall Ventiduct” created by filling a chamber with water, thereby forcing out the air, could be “sufficient either to refrigerate a roome in Summer, or to animate any . . . Bird, blow the Fire, [or] turne any Image or wheele.”<sup>141</sup> Similarly, through the “rarifaction” of air by heating, one could create a stream of wind; this wind could then turn a cogwheel that could pluck wires to play a tune or

make another patterned sound, as in the case of the “celebrated statue of Memnon, which is reported to have spoaken & uttered a voice like a man, so soone as the Sun arose & darted his rayes upon it.” The same wind, Evelyn noted, might “also serve to make artificiaall Eyes & hands move; And Birds furnished with proper calls & whistles, will be heard to sing, to move their tails, heads & clap their wings.”<sup>142</sup>

In sum, hydraulic and mechanical figures became commonplace. Treatises such as De Caus’s and Evelyn’s helped to spread familiarity with hydraulic antics below the sphere of popes and princes. Martin Löhner, a hydraulic engineer and the Master of Wells [Brunnenmeister] for Nüremberg, established a much-visited host of automata at his own comparatively humble house: Vulcan laboring at his forge; Hercules bludgeoning his dragon; Acteon surprising Diana and her nymphs in their bath, whereupon Diana threw water at Acteon, who turned away, grew antlers on his head, and was attacked by his own dogs; Cerberus spitting fire at Hercules; a lion emerging from his cave to drink from a basin, then retiring; the nine Muses, each engaged at her appointed art.<sup>143</sup> Waterworks were *de rigueur* not only for popes, cardinals, archbishops, and kings, but also for ministers. Richelieu had his own at his residence at Reuil. Evelyn, visiting in 1644, pronounced that garden “so magnificent, that I doubt whether Italy has any exceeding it.” He recorded having been shot by streams of water, on his way out of one of Richelieu’s grottoes, from muskets held by “two extravagant [automaton] musketeers.”<sup>144</sup>

One might think the joke would wear thin, but one would be wrong. The sport proceeded right on through the seventeenth century. Evelyn described with malicious satisfaction, circa 1660, the “wayes of contriving seacret pipes to lie so as may wett the [gazing] Spectators, underneath, behind, in front and at every side according as the Fontaneere is pleased to turne & governe these clandestine & prepostrous showers.” Evelyn included, for example, a design for making “a chaire which shall wett those that sit upon it, though no water appeare.” The functional features are a water-filled cushion attached to a pipe that rises through the back of the chair and has an opening, concealed in “the carvd head of a Lyon or some other beast,” at the top. Thus when the victim sits down on the cushion, he unknowingly squeezes water up into the pipe to “spurt into his neck immediately.” This “waggish invention,” Evelyn said, he had found in the garden of the Pope’s cross-bearer.<sup>145</sup>

The gulled continued to take their licks with unflagging surprise and delight. Anne-Louise d’Orléans, *duchesse de Montpensier*, the memoirist and wayward cousin of Louis XIV, cheerfully recorded her experience at the Essonnes estate of the master of finances for the royal household, where she visited with her friend, Madame de Lixein, in the summer of 1656:

As I passed through a grotto, they released the fountains, which came out of the pavement. Everyone fled; Madame de Lixein fell and a thousand people fell on her. . . . We saw her being led out by two people, her mask muddy, and her face the same; her handkerchief torn, her clothes, her oversleeves, in short, disconcerted in

the funniest way in the world, and I cannot remember it without laughing. I laughed in her face and she started laughing too, finding that she was in a state to inspire it. She took this accident as a person of humor. She took no meal and went right to bed. . . . Upon returning, I visited her: we laughed a lot again, she and I.<sup>146</sup>

Robert Darnton has suggested that historians take note of the mystifying jokes of the past, as these indicate “where to grasp a foreign system of meaning in order to unravel it.”<sup>147</sup> To what exotic tapestry do these mischievous machines in their endless funniness connect? Bergson described the quintessential comic situation as “something mechanical encrusted on the living”: the appearance of a human being as an automaton. We laugh, Bergson claimed, as a “corrective”: to reassert the distance between machinery and life.<sup>148</sup> But, as Darnton’s recommendation assumes, humor has a history<sup>149</sup> and the need to establish that human beings are not machines cannot have had the same urgency in 1500 or 1600 as it had in 1900. Rabelais’s, not Chaplin’s, was the sense of humor at play. The frolicsome engines cataloged in this essay represented something like the opposite of Bergson’s scenario: not people as rote automata but machines as responsively alive. The machines’ human targets, laughing at the machines’ whimsical vitality, do not seem to me to have been reasserting their own transcendence of machinery. I think they were doing something more like delighting in a base corporeality that they thought anchored even the very highest of human lives in an actively material world.

Arriving, then, at the mid-seventeenth century, when the idea of the animal-machine began to flourish in philosophical discussion, we can see that mechanical images of living creatures were already everywhere. They were familiar, not only to the nobility and the wealthy bourgeoisie, but to their servants, and to the engineers and the artisans who built the machines, as well as to the audiences who flocked to witness them, and the literate who read about them. The culture of lifelike machinery surrounding these devices projected no antithesis between machinery and either divinity or vitality. On the contrary, the automata represented spirit in every corporeal guise available, and life at its very liveliest. Here, then, was the culture that gave rise to the seventeenth-century animal-machine. That comparatively confined being represented a narrowing of intellectual and cultural possibilities. To make full sense of this development, we must consider the world that preceded it. Before machines became mindless and rote, they were the life of the party.

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