To the memory of Arnold Greenberg, whose love of gadgets proved infectious
Gazing on Technology: *Theatrum Mechanorum* and the Assimilation of Renaissance Machinery

KENNETH J. KNOESPEL

Although Renaissance illustrations of pumps, pulleys, and water mills may catch our eye in history books or on public television, most often we view them as antiquarian curiosities that only hold our attention momentarily, like displays in a museum. When we look more carefully at the iconographic tableaux found in the earliest published illustrations of machinery, we find social codes that tell us much about their assimilation. My intention in the following essay is to identify some of the mechanisms used for the assimilation of Renaissance technology. In particular, I want to emphasize how the narrative responses provoked by Renaissance machines and their graphic representation function as a means for the social absorption of new technology. The theatrical metaphors used in titles and visually displayed in books provide a departure point for asking how we look at machines.

My discussion has three parts. The first introduces early books on machinery and considers specific illustrations and their accompanying explications. The second notices how Renaissance gardens—real and imaginary—provide a narrative setting for staging a broader cultural legitimation of machinery. The third argues that the visual framing of machinery that takes place in pictures or in texts through the use of metaphor may be regarded as a mechanism for transferring authority and the illusion of autonomy to machines or as a means for generating narratives about how they work and how they may be applied.

Several assumptions accompany my discussion and I want to voice them at the outset. One involves an awareness that we cannot expect to approach Renaissance technology unaffected by our own highly technologized culture. Another recognizes that technology...
does not appear abruptly in the Renaissance but involves a maturation of processes already present in the Middle Ages. Still another assumes that thinking about technology engages one in negotiating between detail and abstraction. In an important book on technology, Langdon Winner suggests that what we need are “inquiries that stand somewhere between the ultimate ‘Being of beings’ [a reference to Heidegger’s work on technology] and the latest squabble on this or that social gadget. One must seek simultaneously to avoid depths without direction and details without meaning.”1 I would situate this inquiry “somewhere between,” aware that at times some may find it moving too far in one direction or another. Finally, Winner’s comment has a bearing on all the essays in this book inasmuch as literature—understood not simply the canonical literary genres but texts in that term’s broadest meaning—compromises a relay or “somewhere between” the presence of technology in the world and the reflections it provokes.

The theatrical metaphors that abound in Renaissance book titles represent not only the resurgence of drama but the expansion of technology. As Frances Yates and others have shown, theatrical metaphors, grounded in architecture and optics, become encyclopedic devices for bringing order to phenomena as various as memory systems and fishing manuals.2 Broadly conceived, visual metaphors such as the theater or the mirror permit access to what Christian Metz has called a culture’s scopic regimes.3 What Metz has in mind is simply that our ways of thinking are intimately bound with our sense of sight. In contrast to the medieval metaphor of the mirror, the perspectivalism of the Renaissance theatrical metaphor asserts an even more active and controlling presence of the observer at a distance. The theatre is not casually associated with perspective but architecturally affirms both a practical and theoretical interest in optics.4 Because of the broad metaphoric extension of perspective in language and the graphic arts, there is virtually no area of thought in the Renaissance left untouched by the idea of theatrically framing experience. Even a cursory survey of titles in the Short Title Catalogue of Books Published in England indicates the popularity of such metaphors.5 In fact, the very proliferation of such titles in itself is one indication of the very assimilation of the technology of perspective. The books that advertise themselves as theaters for machines and instrumentation—the theatrum mechanorum—and the others that represent machines are part of this cultural fascination with the visual staging of knowledge.

Gazing on Technology

Although we commonly think of Leonardo da Vinci’s drawings of his inventions as the first modern illustrations of mechanical devices, they were virtually unknown during the Renaissance. The first books devoted solely to machinery—inspired by the mechanical studies of Ctesibius, Philo of Byzantium, Hero of Alexandria, the machines in Book 6 of Georgius Agricola’s De re metallica (1556) and the construction engines included in Book 10 of Vitruvius’s De architectura—appear in the last half of the sixteenth century.6 Jacques Besson’s Livre des instrumentes mathematiques et mechaniques (1569) introduced and popularized a genre that came to include Agostino Ramelli’s Divers et artificiose machine (1588), Vittorio Zonca’s Teatro Nuovo di Machine et Edifici (1607), and Georg Andreas Böckler’s Theatrum machinarum novum (1662).7 In the most pragmatic sense, these books circulated as advertisements for their inventors. Besson’s book, for example, extended the command performances he put on for nobility and attracted attention not only to machinery but to himself.8 The illustrations are, however, much more than marketing tools. By placing before the observer an array of machines that illustrate the application of mechanics, the books also fostered the study of mathematics and Archimedes in particular. If we wish, we may think of them as the first modern recruitment literature for civil engineering. Here the mechanical wonders described by practitioners such as John Dee in his Preface to Euclid’s Elements (1570) are visually demonstrated.9 “Readers who turned the pages of Jacques Besson’s appropriately named Theatre of Machines were witnessing a dramatic spectacle that previous scholars had not seen, just as readers of Agricola and Versalius had their eyes opened to ‘veins and vessels’ that had been less visible before.”10

Just what kind of spectacle did readers confront in these volumes? To discern more exactly what was portrayed, we must consider further the ways theatrical metaphors function in these books. The titles themselves invite readers to approach the books as collections of views and broadly suggest the way the sixteenth-century theater was regarded as an architectural structure that directed the vision of an audience to particular scenes. Scenographia, the Greek word for perspective popularized by Vitruvius in De architectura, marks a fascination with visually ordering knowledge. The word literally designates the graphic ordering of sight-lines for the purpose of creating an optical illusion.11 In practice, scenographia, as
Figure 1. Title-page of Georg Andreas Bäckler's *Theatrum machinarum novum* (Nurnberg, 1662).

Figure 2. Jacques Bosson, *Livres des instruments mathematiques et mechanique* (Venenza, 1582) (Plate 52).

Figure 3. Antonio Ramelli, *Diverse et Artificiose Machine* (Lyon, 1588) (Plate 46).
Böckler’s illustrations—at once civic and secular—bear the expectation that they may be carried out. By giving a preview of what is to come, the illustrations may be compared to modern architectural drawings or computer-generated images that insert still-imagined buildings within a landscape of familiar structures. By staging machines, these Renaissance folios provide a glimpse of how technology may be assimilated.

The distinction between the narrative mode of Italian Renaissance painting and the descriptive force of northern European painting offers a useful way for approaching the illustrations of machinery and the way they order perception. Compared to Italian painting that used perspective to stage stories drawn from the Bible or from poets such as Ovid, northern painting becomes engaged in descriptive exploration that opens possibilities for more localized narratives. While idealized images from the Bible or classical antiquity become enframed in much Italian painting, in Dutch painting the world extends beyond the frame. The representation of machinery offers an example of a visual mode whose departure point is description rather than narrative. Here we must be careful not to make a simple either-or distinction between description and narrative. While narrative is removed from the portrayal of machinery as the primary vehicle of representation, the illustrations provoke narrative on a different level. As the observer responds to the images—images removed from the metanarrative provided by mythological stories—narratives are formulated that work toward the very assimilation of technology. In fact, the illustrations of machinry function in a manner similar to a variety of new descriptive images such as Galileo’s representation of the moon or Leeuwenhoek’s images of microscopic bodies. The narratives are a means for thinking the devices into the world. By provoking assimilating narratives, the illustrations function as relays. Even if a particular machine is rejected as impractical, the technology itself is not rejected, for there may be a setting in which it finds application. Besson includes a plate depicting a mechanical fan that initially appears impractical because of its sheer size. Even though one may reject the application depicted, one recognizes that the mechanism may be applied to a stamping mill as well. Rather than providing grounds for their rejection, the interrogation of machines creates grounds for the machines’ incorporation.

The illustrations also invite us to view these machines as visual puzzles. Besson’s illustration of a fire engine—the first known published illustration of such a device—supplies an example (figure 2). Response to the image may be tracked by formulating three simple
questions: (1) What am I looking at? (2) How does it work? and (3) How does the apparatus apply to the world I live in? The answer to the first question comes by recognizing the burning building and an apparatus used to direct water to the flames. The second follows the observer's inspection of the picture and the association between the cranking mechanism, the water being poured into the engine and the stream of water coming from the nozzle. This answer, however, is only provisional, for the illustration does not supply enough information for the reader to understand the physical workings of the engine. A detailed answer to the second question must await further study, consultation with the author, an actual effort to construct the machine, or a combination of all three. The response to the final question may well determine whether or not the observer decides to learn more about the apparatus before him. In the case of the fire engine, applicability may be self-evident but may also lead to practical questions about efficiency or the proximity of a water source.

The second edition of Besson's work offers an example of how the illustrations provoked commentary. While Besson's first edition of 1569 included the plates with simple descriptive titles, the edition published in 1578 included more detailed explication by François Beroald. Each machine is not simply labeled but, following a practice drawn from classical texts on mechanics, referred to as a proposition. Proposition 52—the fire engine—reads: "A kind of new invention useful for casting water on a fire especially when the flames are so intense that they prevent anyone from approaching the burning building." A description of the fire engine—titled "Declarat. de la LII Figure"—follows. The headings used by Beroald are revealing inasmuch as they present the machines as arguments.

Another feature of Beroald's commentary may be mentioned before considering Beroald's description of the fire engine. Besides authorizing each machine within a tradition of mechanics by referring to them as propositions, Beroald maps the machines by including a rudimentary scale for measurement. A special page (fol. a 4 recto), devoted to formulating special terminology, appears at the end of the Preface.

To better understand the machinery you will notice these (figures) on all the illustrations (whether they are configured one way or another). Since the top of the page is called the north, the line at the top edge of the plate is called the northern line. The foot (of the page) is called the south and the edge of the plate that turns in this direction is called the southern line. The side (of the page) facing the binding is called the west and the edge of the plate which faces it is called the western line. The opposing side of the page is called the east and the corresponding line of the plate is the eastern line. In addition, even though letters do not appear on the plates to provide guidance, I would point out that I replace them by using a measure divided into twenty four parts. All of this appears on the following page which is made available for your benefit. (fol. 3 verso)

Beroald has in mind a system of measurement that may be compared to the grid system used by a draftsman or cartographer. Quite simply he uses one form of technology—measurement—to promote the understanding of another. From a sixteenth-century vantage point, the schema is analogous to the compass or wind tables at the beginning of map collections. In effect, Beroald implies that just as one might orient a map relative to a constant table of directions, one may map the layout of measurement of a machine to meet a recognized standard. The references to Septentrion, Septentrionale, Midi, Meridionel, Occident, Occidentale, Orient, and Orientale in his explication refer to such a grid. What is striking is the effort to map the machines within an idealized space that is expected to be shared by the readers.

Beroald assumes the reader has the table of measurements in mind as he studies his description of the fire engine.

The entire machine rests on two wheels; the middle of the machine is 2.m.12.p south and 22.p east. The machine is supported on four feet at the following distance from the above mentioned lines: 2.m.2.p and 4.p for the one pair and 18.p and 18.p for the other, these being the feet which are attached by two hooks. At the northern end there is a strut to break the machine. (fol. E 2 verso)

While Beroald's description provides remarkably detailed measurements for thinking about the engine, it does not supply knowledge sufficient for its construction. At best the information supplied by the illustration and the commentary creates an intermediary space that might entice the reader to develop the additional expertise necessary to realize the engine.

An even more sophisticated visual presentation of machinery appears in Ramelli's staged presentation (figure 3) of an Archimedean screw (1588): We explore the waterworks with our eyes much as a stage set would be investigated in anticipation of action. The illustration is divided into three planes: the background landscape; the apparatus in the middle ground (an archimedean screw driven
by an undershot water wheel); and the foreground (a cutaway illustration of the screw with cogs and gears). The force of the illustration comes from the stone wall and floor that draw the planes together and orient our exploration of the picture. Here architecture quite literally stages the machinery and explains its relation to the landscape beyond the wall. The natural scene beyond the wall is being harnessed to run the machine. Just as nature itself draws upon the stream to nourish vegetation, humans may now use the stream to drive a waterwheel and foster their own enterprise. We notice other details as well. While the control of nature appears to be the general purpose of the machine, the machine itself has no specific application in the illustration. We see before us—as in many of Ramelli’s machines—an image of perpetual motion that may well remind us of Escher’s modern graphics. The water that drives the machine and that is drawn up into the mechanism drops into a pipe to once again return to the stream. The image offers a glimpse of a circuit—an ingenious thought experiment—whose application or extension is left to the audience. Ramelli’s machine stands before us as a conceptual blueprint.

The walls in the illustration alert us to a further extension of nature as well. Rather than viewing the pump on an enclosed prosenium stage, we view only a corner of a larger setting. Instead of encircling the machinery, the wall extends beyond the border of the picture. Ramelli stages the machine not within the arches of a prosenium stage but within a fragmentary setting that waits for incorporation into the world. Much as the walls invite extension, the machinery itself waits to be coupled to other devices. By depicting the connection of a waterwheel to a water screw, Ramelli indicates his interest in such complexity. Ramelli is hardly alone in depicting the mechanical elaboration of technology. The manuals do not set forth simple mechanisms but show an attraction to assemblies that may be adapted or interconnected.

That Ramelli is primarily interested in the general principles demonstrated by the machine appears in his commentary. Rather than including engineering specifications for parts of the engine as Besston and Beroald, Ramelli draws attention to a progression of events caused by the water’s natural force.

The nature of this machine is no different than the preceding one, as one notices, (except that is is for pumping water) and serves to pump water from a canal, river, well, or similar place to a convenient height. By turning the wheel marked Z by the force of the water in the canal or river mentioned above, the water is taken up by the small paddles (as you see in the drawing) to the first receptacle marked H. At the same time, wheel N makes wheel T turn which is geared to wheel Q connected to the covered screw drive marked A. Wheel N (as one notices) is connected to the same gear. This gear is made in the same way as the others. By its turning it takes the water from the first receptacle to the second marked R, and then to the third marked S by the very movement described above in regard to wheel N which gave it movement taking with its teeth the cogs of lantern-like wheel marked M,” which is geared just as was described above. In the same order, gear K takes the water from the third receptacle and as it turns brings the water to the fourth and final receptacle where by means of a pump (as one sees in the figure marked V) one can make the water descend or lead the water wherever it is most useful. (p. 70; Paris, 1588)

To a modern audience, the cumbersome description of the machine—even more evident in the French original—stands in stark contrast to the clarity of the illustration. After noticing that the machine is a variation of the previous one in the collection, Ramelli indicates how the individual parts are connected through a cause-effect relationship set in motion by the power of the water. The conjunctions in the prose actually become a reflection of the machine’s own gear work. Even the machine’s artifice, which is noted at the very beginning, lies in its ability to use natural force to cause a mechanical chain reaction. By keying the major parts of the machine, the author makes it apparent that he intends the text to be an aid in studying the illustration. Even when combined, however, the image and the text hardly provide sufficient information to construct the machine. Rather, the ensemble sets before the reader a thought experiment that promotes access to underlying principles.

Ramelli’s account, like Beroald’s, challenges the reader to fill in diverse information. While the machine’s purpose is certainly conveyed, the question of its practical construction remains a matter to be supplied by a very different set of narratives. Finally the machinery reminds us that an entire level of practical discourse remains absent from the presentation for the simple reason that it is assumed to be related through spoken instructions. In fact, as we look at these pictures we need to imagine how each marks an entry point of a myriad of narratives that cannot be recalled because they were not written down.

Although I have concentrated on individual scenes, I want to notice that such fragmentary images also contribute to a larger social assembly. As the illustrations provoke the formulation of assimilating narratives—indicated by questions explored above—
they also invite the reader to review the social organization implicated in the operations depicted. Besson’s depictions of floating pile-drivers, cranes, and dredges are not isolated vignettes or fragments but open to express a larger social interest in land reclamation and harbor improvement. We might think of such images as “postcards” giving us glimpses into the larger civil projects well underway in the Veneto and in Holland during the later half of the sixteenth century. In other words, at the same time that the machinery provokes the observer to devise individual narratives to explain what is going on, it is already assumed to be part of a larger social process.

The drama surveyed in the illustrations found in Besson, Ramelli, and Böckler denotes transformations not only in the status of nature but in the role of human beings. The illustrations indicate that a transition has taken place in the idea of the actor, for the focal point within the illustrations has shifted from the human to the mechanical. In the Ramelli illustration considered above (figure 2), the pump dominates the scene and becomes a quasi actor within the landscape. When humans are included in illustrations such as Besson’s fire engine, their servient status only strengthens the central role of machines. Böckler shows a more developed awareness of how machines alter the status of workers as well as owners in his seventeenth-century illustrations. In one, a curtain has been drawn aside to reveal a couple at leisure eating dinner while the mill, tended by workers, operates on the floor beneath them (plate 53). Here the machine begins to determine the roles played by humans. The various illustrations portraying humans attentively watching a machine’s operation indicate even further the centrality of the apparatus in the drama being portrayed.

Although machinery receives a central position in these illustrations, it would be wrong to view such technology as autonomous in any way for such machines are invented and operated by human agents even if such agents are not present. In fact each machine should be thought of as a separate sculpture-like creation controlled by separate operators. A comparison of the machine illustrations and sixteenth-century emblem books suggests one way these images conferred authority on their audience. Just as Andrea Alciati’s Emblemata (1531) requires the reader to puzzle out hidden morals, Ramelli’s illustrations challenge the reader to puzzle out hidden mechanical relations. For example, in the Ramelli illustration of the fountain system, the cutaway depiction of a pumphouse indicates that a concealed apparatus supplies water for the fountain system (figure 4). In effect, Ramelli educates the reader to expect that machinery exists behind a scene, much like Alciati educates the reader to expect moral significance. The emphasis on concealed pumps, pipework, pulleys, and gearworks—often exhibited through superimposed and cutaway drawings—indicates that the machine illustrations work much like allegorical handbooks in their assumption that knowledge comes only when one has been initiated in an explanatory code. Indeed, such comparisons are actually implied by Ramelli in his Preface. Rather than appealing to an unstated system of moral values, the images in the machine books respond to a body of practical knowledge. While the emblem books direct the reader to a moral superstructure, the books on machinery impel the reader to what we may call a superstructure in mechanics and mathematics. Much like the allegorical superstructure that controls a Botticelli painting, a techno-mathematical code implicitly controls the illustrated machinery.

However, while the mathematical practitioner—one of the many persons literally behind the scene—controls the machinery, human agency also becomes circumscribed by the very apparatus. Once constructed, the machine dictates not only its own maintenance but also its own improvement. Ramelli’s pumps illustrate not only his inventiveness but the way that technology begins to determine where and how invention may take place. To a considerable degree, Ramelli’s machines are extension of each other. Just as mythographic handbooks supplied components that could be combined inventively, the mechanical handbooks provided departure points for invention. Just as the cogs and gears of the pump must connect for the engine to work, the machines themselves wait to be applied to new tasks and even to be linked to other machines. The successive portrayal of pumping mechanisms shows a fascination with exploring various applications of the new technology. Just how the new mechanisms could be applied, however, becomes the domain not of the single hero but of the humans required to maintain and manipulate the new codes. While it may be tempting to imagine a single human agent or practitioner in control of the machine, we must be careful not to approach the machine or the human with a singular idealizing narrative that blurs the complex intersection of narratives that accompany and sustain technology.

In Utopia (1516), Thomas More refers to the world as a machine: “He has set forth the visible mechanism of the world [mundi huius visendam mechanam] as a spectacle for man.” More’s simile alludes not only to the many components that must fit together if the social engine is to operate but also to an assumption that the engine should be seen as a whole. If we wish, we may think of his com-
parison as looking toward urban planning. The books considered above appear a little more than a half-century after *Utopia* and indicate that the broader social narrative associated with urban planning is no longer simply a dream.

PUMPS IN THE BOWER OF BLISS: NARRATIVE RESPONSE TO THE VISUAL REPRESENTATION OF MACHINES

The problems staged in the books by Böckler, Besson, and Ramelli comprise more than isolated thought experiments. Some of the ideas represented in these collections become literally exhibited in Renaissance gardens such as the garden of the Villa d’Este at Tivoli (1565–1575) and in the Pratolina garden (1569–1584) outside Florence. Such Italian gardens and the projects they influenced in the north function not only as beautiful sites but as laboratories or test sites for technology. Besides being physically realized, however, the mechanical ideas are also set within a specific narrative context. As the observer moved through the new Renaissance gardens, he simultaneously undertook an allegorical journey based on established mythographic stories and encountered an array of new technological devices that challenged him to a new awareness of technology. For the Renaissance observer, the movement from moral to mechanism was facilitated by the academic distinction between moral and physical allegory. What was new was that the Renaissance observer found that the distinction between physical and moral allegory was no longer simply a conceptual distinction but a physical one as well. Renaissance gardens became at once stages for reviewing traditional narratives, showcases for technology, and sites for their conceptual integration.

When the Elizabethan traveler Fynes Moryson saw the hydraulic automata of the Pratolina garden in the middle of the 1590s he described them with fascination. "There is a Cave, vulgarly called la grotta Maggiore. . . . In the said Cave, a head of marble distillett water; and two trees by the turning of a cocke shed waters abundantly, and a little globe is turned around by Cupid, where the Images of Duxes dabbled in the water, and then looke round about them; and in the midst of a marble table is an instrument, which with great art and force, drieth water into any furthest part of the Cave." In another grotto "certaine images of Nymphes are carried by the water out of the Cave, and in again, as if they had life"; in another he discovers "the image of Fame doth loudly sound a

Trumpet, while the Image of a Clowe putteth a dish into the water, and taking up water, presents it to the Image of a Tyger, which drinketh the same up, and then moves his head and looke around about with his eyes." Moryson concludes by saying "I know not any place in the World affords such rare sights in this kind."

The Pratolina garden visited by Moryson was broadly modeled on the earlier Este water garden at Tivoli. In a descriptive catalog of the garden composed for Catherine di Medici, probably in 1571, the author lists sixty-five different marvels to be seen in the garden including the Fountain of the Water Organ. The focal point of this fountain, begun in 1568, was a statue of the many breasted Diana of Ephesus, also referred to as a statue of Nature or Fortune. A water organ behind the statue was set in operation by the rush of water that simultaneously forced air through organ pipes and triggered mechanical controls opening and closing the pipes. "The voices of many animals and sounds of almost all the instruments as beautiful as music are represented in these mechanisms" (145). [In essa si dovevano rappresentarle voci de molti animali et suoni di quasi tutti gli'istrumenti così bellici, come musici.] The spectacle so intrigued Pope Gregory XIII, when he visited the garden in 1572, that he requested to meet its inventor, Claude Venard.

Edmund Spenser’s contemporary, Thomas Nashe, who visited Italy in the 1580s includes a long account of a Roman garden with automata in *The Unfortunate Traveller*. "Why, you should not come into any man’s house of account, but he had fish-ponds and little orchards at the top of his leads. If by rain or any other means those ponds were so full they need to be sluiced or let out, even of their superfutities they made melodious use, for they had great wind instruments instead of leaden spouts, that went dulcely on consort, only with this water’s rumbling descend" (267). Surrounding a banquet house, the traveller observes a "conspiracy of pine trees" (268) that offers a perch for songbirds.

Who though there were bodies without souls, and sweet resembled substances without sense, yet by the mathematical experiments of long silver pipes secretly entrined in the entrails of the boughs whereon they sat, undiscernibly conveyed under their bellies into their small throats’ sloping, they whistled and freely caroled their natural field note. Neither went those silver pipes straight, but, by many edged unsundered writhings & cranked wanderings aside, strayed from bough to bough into a hundred throats. But into this silver pipe so wirited and wandering aside, if any demand how the wind was breathed: Forsooth the tail of the silver pipe stretched itself into the mouth of a great pair of bellows, where it was close soldered, and baled about with iron, it could
Italianate gardens, influenced by the Este and Pratolina gardens, could be found at Kenilworth, Theobalds, Nonesuch, and Hampton Court. By 1600 Lord Burghley’s garden at Theobalds (constructed between 1575 and 1585) had become the subject for a travel description in its own right.

There is a fountain in the centre of the garden: the water spouts out from a number of concealed pipes and sprays unwary passers-by.

In the first room there is an overhanging rock of crag (here they call it a “grotto”) made of different kinds of semi-transparent stone, and roofed over with pieces of coral, crystal, and all kinds of metallic ore. It is thatched with green grass, and inside can be seen a man and a woman dressed like wild men of the woods, and a number of animals creeping through the bushes.

Another contemporary visitor describes the labyrinths, pools, and entertainment rooms and other visitors noticed “a little wood nearby. At the end you come to small round hill built of earth with a labyrinth around. [It is called the Venusberg.]”

The development of technologically landscaped gardens in the sixteenth and seventeenth centuries also corresponds to gardens in Renaissance poetry. The link between technology and the poetical representation of gardens is not surprising, considering that in medieval settings such as the Roman de la Rose, the garden was not an artificial structure for some ponderous, moral allegory but offered a setting for developed discussion of physical phenomena. For Jean de Meun, who probably was a professor of natural philosophy at the University of Paris, the fountain becomes a vehicle for an informed discussion of optics. Renaissance literary scholarship has so frequently assumed classical and medieval sources for the gardens in Renaissance pastoral and epic poetry that it tends to overlook how the representation of Renaissance gardens in poetry also registers curiosity regarding science and technology.

Spenser’s Faerie Queene offers a significant example, for it invites us not only to survey poetic gardens from antiquity to the cinquecento, but also to explore technologically perfected gardens. While the Bower of Bliss portrays a developed allegory of sensuality set off by Guyon’s temperance, it includes features similar to the Renaissance gardens being engineered for wealthy nobles during the later half of the sixteenth century. Comprising many acres, the Este and Pratolina gardens and their English counterparts included an array of mythological settings that were intended to be discovered separately. Entry to an outdoor banquet house or
pavilion replete with fountains and mosaics representing mytho-
logical themes could be on the culmination of one’s progression
through the garden. Guyon’s progression through a variety of
visual stations on his way to the intimacy of the Bower of Bliss
describes a movement that would have been familiar to a Renais-
sance reader aware of the new Italian gardens with their con-
structed grottos and banquet rooms. The description of rolling
waves without wind (2.12.22), metallic boughs and ivy (2.12.55), a
fountain-lake “three cubits deep” (2.12.62)—all make it appear
that Spenser’s garden is shaped with the artifice found real as well
as poetic gardens. Once it even appears that Spenser could be de-
scribing not only painted metal but metal that had literally turned green
through oxidation.

And over all, of purest gold was spred,
A trayle yeue in his native sty.
For the rich mettall was so coloured,
That wight, who did not well advis’d it view,
Would surely deeme it to be yuile trewe.

Within the decorous but unfortified confines of the garden, Guyon
discovers a fountain with “infinit streames” (2.12.62) flowing into a
pool with a mosaic bottom. While such a stream is a common trope
in itself, the figures moving within its rushing water are described
like the mechanical statues in the Pratolino garden.

Sometimes the one would lift the other quight
Above the waters, and then down againe
Her plong, as over master’d by might,
Where both awhile would covered remaine,
And each the other from to rise restraine;
The whales their snowy limbs, as through a vele,
So through the Christall waves appeared plaene:
Then suddenly both would themselves unhelie,
And th’ amorous sweet spoiles to greedy eyes revele.

Rather than being celestial in origin, the pleasing music heard by
Guyon as he progresses further seems to have its source in a water-
organ.

Eftsoones a most melodious sound
Of all that mote delight a daintie ear,
Such as attence might not on living ground,

The comparison of the Bower of Bliss to mechanical gardens
found outside Tivoli, Florence, or London would make much sense
to a Renaissance reader. Although we may be more inclined to think
of a Renaissance response to technology in Donne or in Jonson’s
masques designed by Inigo Jones, the new interest in science and
technology presents itself in works written by an earlier generation
as well.

With a broader awareness of Renaissance technology, we discern
that The Faerie Queene challenges readers to recognize tech-
nological as well as poetic artifice. The presence of technology in
the Bower of Bliss finally intensifies Guyon’s warning that one
cannot trust appearances. When Guyon destroys the Bower at the
end of Book III, we can imagine Spenser quite simply turning off
the machinery that has kept the garden in animation. Even the
representation of a figure like Archimago in Book I may be read as a
warning regarding the new mechanistic capacities claimed by late
sixteenth-century engineers. Ultimately the artificial schemas and
engines that appear in Spenser’s poem remind us of how the ro-
mance genre could function as a narrative instrument for testing the
specific engines that were appearing at the end of the century and
for revealing the uncritical manner in which they were being re-
ceived. The ingenious pumping mechanisms displayed in Besson
and Ramelli may contribute more than we expect to the artificially
engineered landscapes of the Faerie Queene.

Gardens, whether set out in Renaissance poetry or on the estates
of the nobility, offer a controlled means for assimilating the new
technology. In each case, the audience views the machinery at a
privileged distance as it would an entertainer. But something more
is at stake as well. By placing automata within the context of
traditional mythological narratives, the illusion is created that the
comprehension of the mythographic code also entails the control of
the technological code. Each time the visitor describes what he or
she has seen, narratives are generated that facilitate the continued
assimilation of technology. It does not matter whether the mechani-
cs of the machinery is understood. In fact, the garden conceals
technology in its mythological narrative. Gardens really become precursors of industrial exhibitions and amusement parks such as Disneyland, where the modern cartoon pantheon shapes the way the visitor views the technological marvels of Tomorrow Land.

The theatricality of the illustrations in Besson, Ramelli, and Böckler remind us how existing modes of representation were used for the assimilation of the new technology. Finally, the theatrical enframing of technology in engravings, in grotto scenes of Renaissance gardens, or in poetry conveys an important tension. Although the staging of technology holds the audience at a distance and idealizes the mechanism, the narratives generated by the representation challenge the visual idealization of the machinery. At the same time that works by Besson, Ramelli, and Böckler idealize machinery, they also promote the aura of the know-how to build the mechanisms. The machine is never simply a spectacle to be framed and viewed at a distance but a social relay that anticipates the physical transformation of nature as well as the alteration of human life. An illustration in Böckler plate 49 that depicts a man watching a waterwheel suggests fascination with the process as well as entertainment. Above all, it suggests that the process has become entertaining precisely because the machine has taken the place of men and other working animals. Böckler emphasizes this detachment in other illustrations by showing unbridled horses around waterwheels and men and women occupied with tasks separated from the machinery. Ultimately the separation of the audience and machine is momentary because the machine transforms all observers into potential figures for generating assimilating narratives. Because machines cannot speak, the audience is called upon to speak for them.

We may characterize the larger narrative enacted by the audience as it turns from one illustration to the next. As the audience explores the machines and through imagination tests their assimilation into the world, it participates in a romance. Romance characterizes the process of assimilation because it describes the way in which the audience’s puzzling over these illustrations enacts a search to understand how the machines may be understood and applied. There is another facet to the romance as well. The path that the romance takes is finally not simply the result of the narrative response to machines. Once constructed, the machines stand outside of the narrative process that facilitated their realization. In effect, when realized, the machinery itself participates in an evolving romance. Although the reader or observer may momentarily believe that he can control the machines by theatrically framing them, such images ultimately serve as a means for their proliferation as much as a means for their control.

VISUAL FRAMING AND MYTHIFICATION

At a rudimentary level the illustrations of Renaissance machines are a means for disseminating ideas. They are not, however, iconographic narratives that may be resolved with allegorical schemas drawn from classical or Biblical texts, but representations that also provoke different forms of response. In the final section, I want to review the narrative responses provoked by such illustrations. Before I do so, however, I want to notice how the illustrations participate in defining a new kind of space.

The illustrations considered in this essay define a new way of seeing. In fact, they have a function similar to Galileo’s published illustrations of the heavens or Vesalius’s illustration of the human body. The drawings of the human body published by Vesalius in De fabrica (1543) or the sketches of the moon published by Galileo in The Starry Messenger (1609) do more than share images that had never been seen before. At the same time they tell the audience what it should see, they validate a way of seeing. The drawings by Besson and Ramelli have a similar function for it is ultimately not a question of whether they provide blueprints for the machines but rather a question of the expectation they provoke. Whether they were actually constructed or not does not matter. What matters is their creation of an idealized space for thinking such mechanisms into the world.

The theatrical enframing to which I have drawn attention works as a means for thinking the machines into the world, for it links the visual with the linguistic response. As we study these illustrations we need to be careful not to think of them as theatrical images that distance the viewer from the object, but as images that also provoke local narratives. In his treatise, The Vision of God (1453), Nicholas of Cusa describes a carefully constructed portrait (probably by Roger Van der Weyden) whose eyes appear to follow everyone in the room simultaneously. For Cusa, the portrait functions both as a technological exhibition of perspective and as a metaphoric argument for God’s ability to see each individual at the same moment in time. The double quality of Cusa’s experiment can also be applied to the Renaissance representation of technology. In each case the
gaze of the observer is not neutral, for it either authorizes an abstraction subsumed within a broader cultural code or provokes further investigation.

While the theatrical enframing of technology orients the approach to Renaissance machines, it should not delude us by promoting an illusion of control. There is a double-sided quality to such visual framing that we cannot afford to ignore. The metaphoric duplicity accompanying these Renaissance illustrations may be compared to our own propensity to personify the machines or instruments surrounding us. While personifying a computer or car may make us feel that we dominate the machine, our very language only works to integrate the machinery even more into our world. By calling a computer "user-friendly" we do not imply that we understand our computer's circuitry, but instead advertise the benefits of a particular machine. While metaphors may promote a familiarity that allows our coexistence with technology to continue, they also contribute to its mythification. The location of machines in mythological gardens is an early sign of such mythification. Perhaps the most powerful modern manifestations of such mythification is the prevalent perception of technology's autonomy or its characterization as a Frankenstein out of control. To think of technology as a Frankenstein-like creature hardly asserts control but only serves to mystify our technological creations by projecting onto them greater authority. The narratives we bring to technology need to be examined carefully.

Technology is not a spectacle that momentarily diverts our attention but a medium through which a culture defines itself. Unlike the play set off and viewed at a distance, technology installs itself with physical force and becomes an integral part of the space we inhabit. As we think of technology's integration, its theatrical framing bears different implications. While it may transform an audience into passive observers entertained by a distant spectacle, it also provokes narratives for its interrogation. When applied to technology, the theatrical metaphor has the potential of giving an audience the illusion of control or challenging an audience to devise narratives for assimilation and comprehension.

Besides challenging us to think about the way machinery becomes visually framed, the illustrations provoke several kinds of narrative response. On the most basic level, the illustrations generate local narratives for identifying and describing the machinery. For a given illustration there may be a variety of local narratives involving a simple label as well as a sequential explanation of the machine's workings. But as I have suggested in my comments on Renaissance gardens, narratives operate on a broader level as well as through the metanarratives or conceptual codes used for the cultural assimilation of the machines. The mythographic and romance codes found in Renaissance gardens, the hydrostatic principles implicit in the workings of the machinery, and finally the visual order—the scenographia—implicit in illustrations comprise such metanarratives.

Although seldom acknowledged, another level of narrative presents itself as well. The illustrations and written narratives remind us that technology is bound up not only with writing but with a multitude of narratives that remain unacknowledged because they are unwritten. Each illustration may be thought of as provoking oral or psychological responses as well. Such responses cannot be discounted because they comprise the most common response for explaining and relating to technology. Even though we may not recover such narratives, they may be discerned in the written narratives that remain or in the narratives that we ourselves play open as we look at the illustrations. While Ramelli's book sets before the reader a collection of conceptual blueprints for thinking machines into the world, the actual construction of these machines by artisans assumes the presence of skills that are not conveyed through writing but through practice and oral instruction. As we think of the assimilation of technology, we cannot simply think of written narratives but must also acknowledge the spoken narratives that sustain technology.

The earliest published illustrations of machinery challenge us to ask how we have come to gaze on technology. Besides observing some of the mechanisms used to stage machinery, we have noticed how machines provoke narrative responses that promote their assimilation, and we have identified how the very metaphoric devices used to frame and control technology function as relays that bring it greater authority. Another concern has accompanied the discussion as well. As we have surveyed examples of Renaissance technology, we are reminded that technology requires interpretation. Its interpretation, however, cannot be compared to literary hermeneutics because it ultimately transcends ordinary language as well as the mathematical codes that help bring it into being. We may think of technology as another language written within the very horizons in which we live.

There is an irony here as well. Although the Renaissance efforts to construct a universal language are regarded as failures, do we not discover in the ingenious pumps and mills at which we have glanced the rudiments of an unexpected fulfillment of such aspirations? The
task that confronts us involves the formulation of a hermeneutics of technology that will permit us to deal with such a language even more effectively. Asking how we look at technology comprises a step within such an effort.

NOTES

I want to thank Mark Greenberg and Lance Schacter for their careful reading of this essay in an earlier form.
7. Original dates of publication are indicated in the text. Benson’s work was known as Theatre des instruments mathematicques & mechaniques in all editions appearing after 1578. Editions appeared in 1578, 1579, 1582, 1602, 1594, 1595, 1596, and 1626. I have examined the Lyon edition published in Vicenza in the Price Gilbert Memorial Library of the Georgia Institute of Technology. The following folios were examined at the Newberry Library: Agostino Ramelli Diverse et Artificiosae Machinae (Lyon, 1588); Vittorio Zonca, Teatro nuovo di macchina et edificii per varie et figure operationi (Padua, 1656), and George Andreas Boecker, Theatrum machinarum novum exhibens opera molaria et aquatilia constructum industria (Nurnberg, 1662). See also the fine reprint of Ramelli, The Various Machines of Agostino Ramelli, tran. Martha Teach Grudis with technical annotations by Eugene S. Ferguson (New York: Dover Publications, Inc., 1987). A. G. Keller’s A Theatre of Machines (New York: Macmillan Company, 1964) remains the most available collection of illustrations.

All illustrations and references are to volumes in the Newberry Library. I am grateful to the Newberry Library for permission to reprint the illustrations and, in particular, to Mr. Paul Gehl, Curator of the Newberry’s Wing Collection.

11. “Scenicography est fronti et laterum absentementia acimulatio ad circinque centrum omnium linearum responsio.” [Scenography (perspective) also is the shading of the front and the retreating sides, and the correspondence of all lines to the vanishing point, which is the center of a circle.] Vitruvius, On Architecture. [Book 1.2.2] vol. I, 26–27.
13. “Espace d’artifice nouveau, propre a letter l’eau contre le feu mesmes lors que la flamme empeschce que nul ne peut approcher de l’édifice qui ard.”
14. Pour laquelle mieux entendre, tu noieras ceci en toutes les figures, (soit qu’elles soient disposées d’une façon ou d’autre,) que la teste du livre est nommée Septimention, la ligne du bord de la planche estant pour ceste cause appelle la ligne Septimentionale. la bas, Midi: le bord de la planche tourne vers ce quartier, la ligne Meridionale: la coursture Occident. & le bord qui la regarde, la ligne Occidentale. Opposte, Orient. & la ligne, Orientale. Outreplus, pourquoy qu’il n’y a point de lettres es planches qui servent à demonsther, affin que je te teine au lieu que j’entendr, juseray souvent d’une mesure diverse en mesure qui a qu’elle avec tout le reste est mise en la prochaine page, a laquelle tu pourras avoir recours. (fol. a 4 verso).
15. Toute la machine est menee sur deux roues, dont le moyen de celle qui se voit est loing de la ligne de midi 2 m. 12. p. & d’orien 22 p. & sostenuent sur quatre pieds, dont deux se voient loing des lignes susictes: ascencion 2 m. 2 p. & 4 p. 0.60, & 18 p. & 18 p. l’autre, estaus tous deux tenus en raison par deux crochets, qui viennent de la base; en laquelle au bout septimentionale est une grille pour arrester la machine.
16. L’Artifice de cette machine n’est pas different de la machine precedente, comme l’on voit (excepte que pour conduire l’eau) & sert mesmes pour faire monter l’eau d’un canal, riviere, fontaine, ou d’autre semblable lieu a une convenable haulteur, en cette facion car en se tournant la roue notes Z par la force du canal, ou de la riviere susictes, prend d’elles l’eau avec ses casettes, & la porte (comme il appert par le dessin) dedans le premier recepctacle marque H, & fait en meme temps tourner la roue T, qui est detenue de la roue qui est fichee dans la vis ouverte notes A, la faict tourner en semble avec la autre roue N, qui comme l’on voit) est fichee dedans la mesme vis; laquelle vis est faicte en la forme que represente les autres; & par tel retournement prend l’eau du premier recepctacle avec les troux qu’elle a en bas, & la porte dedans le second marque R, d’une recepctacle la vis L prend l’eau, & la porte dedans le troisiem note S, par le moyen de la roue susictes N qui luy donne mouvement, prentant avec ses dent les visces de la laaterne M, qui est fichee dedans la susictes vis; & avec les mesme ordre, la vis K prend l’eau du troisiem recepctacle, & la porte en se tournant dans le quatresiesme & dernier, d’ou par une pompe (comme l’on voit par celle qui est note V) l’on la fait puis apres descendre ou l’on la mene de la, ou il est plus commune qui a en vet user.
17. For a discussion of the special significance of technology in the Renaissance see Arnold Pacey, The Maze of Ingenuity (Cambridge: MIT Press, 1976), esp. 116–73. For projects in the Veneto see Marinfredo Tofani, Humanism, Technical Knowl-

18. Andrea Alciati, Emblemata (1531); I have used a later version, Emblemata cum commentario (Padoa, 1621, rpt. New York: Garland, 1978).

19. "Mundi huius visendam machinam humana (quem solum tantae rei capacem fecit) exposuisse spectandum: coque charitatem habere: curiosum ac sollicitum inspectorem, operisque sui admirationem: quam cum qui velus animal expressit: tam tranquille spectaculum, superstes immotisque negligit."

[He has set forth the visible mechanism of the world as a spectacle for man, whom alone He has made capable of appreciating such a wonderful thing. Therefore He prefers a careful and diligent beholder and admirer of His work to one who like an unreasoning brute beast passes by so great and so wonderful a spectacle stupidly and stolidly.] The Complete Works of St. Thomas More, Vol. 4. Utopia ed. Edward Schurtz, S.J. and J. H. Hexter (New Haven: Yale Univ. Press, 1955), 182–83.


22. All references included in the text are to the seminal study by David R. Coffin, The Villa D’Este at Tivoli (Princeton, N.J.: Princeton Univ. Press, 1960).


27. As cited in Strong, p. 53.


29. All references to Spenser are to The Faerie Queene, ed. A. C. Hamilton (London: Longman, 1977).


33. Cusa’s metaphorical use of the optical phenomena in The Vision of God is related to his optical research found in his work De Berylio. Specific examples in The Vision of God are related to one of the major medieval optical treatises, Alhacen’s Optics, the Source.