Introduction: Subtle devices: Renaissance humanism and its machinery

> [Tener ingenios auxiliares] Provide yourself with auxiliary wits [engines]. To enslave our natural superiors by cunning is a novel kind of power, among the best that life can offer.
>
> Balthasar de Gracián

This is a study of the ways in which Renaissance writers understand machinery and the practice of mechanics before the rise of the mechanical philosophy. By the middle of the seventeenth century, the discipline of mechanics and machines themselves begin to be understood as participants in, and exemplars of, a cohesive set of scientific theories and a corresponding set of political, ethical, and intellectual convictions. Yet in the century before Descartes and Gassendi, the meanings which scholars and poets attach to mechanical objects and practices are radically different from, and less systematic than, those of their successors. Rather than view machinery as the regulative model of a monolithic natural philosophy in harmony with particular ethical and metaphysical doctrines, sixteenth-century humanists endorse no single mechanical philosophy. Instead, they ally machinery with competing doctrines and attitudes, so that the practice of mechanics becomes capable of confederacy with a dazzling array of concerns distinctive to the intellectual culture of the period.

Humanism, Machinery, and Renaissance Literature argues that sixteenth- and early seventeenth-century culture embarks upon a widespread reconsideration of its attitudes towards instrumentality and artifice stimulated in part by a volatile and conflicted relationship to machinery and to the practice of mechanics. The construction and use of devices including clocks, stage machinery, war engines, and astronomical instruments, as well as representations of these devices in literature and in art, not only reflect but also actively reshape how Renaissance writers define and justify machination as an intellectual or political tool. Rather than focus upon the purely scientific applications of mechanics during the period, this book

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exposes how machinery plays a central and transformative role in the way Renaissance humanists reassess their understanding of all manner of instrumental means, from rhetoric and pedagogy to courtly dissimulation and diplomacy.

By humanists, I mean those writers whose interests and methods are primarily grounded in the *studia humanitatis* – in rhetoric, history, and moral philosophy, rather than in the systematic disciplines of logic or theology. Yet the scholarly activities of many of the writers studied in this book demonstrate that any categorical distinction between humanism and science during the period is precarious at best. Poets including George Chapman and Edmund Spenser reveal a profound interest in mechanics as an instrument of moral discipline or as a tool with which to redefine the relationship between nature and art. From Angelo Poliziano to Henry Savile, some of the most capable scholars of mechanics are steeped in the methods and concerns of humanistic scholarship and vice versa. Bernardino Baldi translates ancient Greek works on mechanics but also writes a laudatory history of the dukes of Urbino, while Francis Bacon writes history and court masques as well as works of natural philosophy.

Renaissance humanists recognize the profound applicability of mechanical practices and principles to extra-scientific questions. These include: the relative merits of theory and practice; the practicality of philosophical ideas such as Stoic *apatheia*, and above all the moral and epistemological challenges posed by instrumentality – the reliance upon instruments and tools, mechanical or otherwise, to effect a particular end. For the several generations of scholars and poets studied in this book, humanistic disciplines and the discipline of mechanics shed mutual light upon each other and are defined by a shared set of concerns and aims.

The applicability of mechanics to the intellectual culture of Renaissance humanism is in part due to the dominant understanding of mechanics during the period as a science of "means and instruments." In his 1612 treatise *Metallica*, the English clockmaker and natural philosopher Simon Sturtevant repeatedly defines mechanics as "Instrumentall means," a definition that implicates mechanics in a broader theory of means that extends to political and intellectual instrumentalities as well as to machines. After establishing the "powerfull efficacie and meanes of his dexterous prerogative instruments," Sturtevant identifies several subcategories of "mechanick invention," distinguishing between "impersonall" and "personal" instruments, or between machines and servants, the living instruments upon whom rulers rely.[1]

Inasmuch as it treats mechanics and politics as sister arts both involving the effectual use of instruments, Sturtevant's definition offers a novel, persuasive model of instrumentality applicable to political and intellectual methods alike. In the preface to *Metallica*, Sturtevant compares his "Litteral" and "Mechannicall" projects to each other, likening his work on mechanics to his "Scholasticall engin *Aucomaton*," a Hebrew and Chaldean dictionary entitled *Dibre Adam*.[2] Sturtevant regards his dictionary as an "aucomaton" – a conflation, in all probability, of *automaton* and *auctor* – in that it offers the scholar the effectual means to translate ancient languages. Sturtevant's perception that *Dibre Adam* is a philological "automaton" is borne out by the terminology of that text's preface, which refers to itself as a "device," an "instrument," and a "literarie Engine" that readers may manipulate "with speedie motion, and turning of a hand."[3]

Sixteenth-century uses of the word *technologia* (τεχνολογια), a Greek term imported into Latin by Cicero, carry similar connotations, referring not to mechanical practices but rather to rhetorical or philological methods. Guillaume Budé's 1554 *Lexicon Graeco-Latinum* defines *technologia* as an art (*ars*) or discipline, or as an artifice (*astutia*, *impostura*, *frauda*), reflecting the commonplace attitude that humanistic learning is the product of human contrivance, and not of nature. Peter Ramus frequently uses the term *technologia* in his work on dialectic to denote a rhetorical technique or a "systematic treatment of grammar."[4] Gabriel Harvey shows his debt to Ramus when he refers in his copy of Cicero's *Ad Atticum* to the "technologia Hopperi," Marcus Hopper's 1563 Greek–Latin dictionary or "artificiosa nomenclatura," as Harvey also calls it.[5] For Ramists, a *technologia* could denote a dictionary or reference text – as is the case with Caspari Streso's 1634 *Technologia Theologica Exemplo Illustrata*, a collation of commentaries on *1 Romans* – or it could denote the methodical ordering of any discipline of knowledge, including the systematic study of the relationship between different scholarly disciplines.[6]

This humanistic conception of *technologia* as polyvalent instrumentalism enables machinery to contribute to the shaping of Renaissance attitudes towards the efficacy and legitimacy of non-mechanical instrumentalities. Many writers seize upon the term *engin*, which denotes both wit and machinery, and the term *virtù*, which signifies political efficacy as well as the motive power of a machine, to foreground the etymologically latent connections between mechanical operations and intellectual or political strategies. The Elizabethan scholar Thomas Blundeville explains in his 1574 *True order and methode of wryting and reading hystories* that his work

explores the "meanes and instrumentes" of historical actions, a formula he repeats in his 1594 *Exercises*, an anthology of practical scientific treatises that likewise instructs its readers in the use of "instruments" including quadrants and cross staffs.[7] Like many of his contemporaries, Blundeville recognizes the similarities between a historical method grounded in the close examination of "means and instruments," or the tangible causes of historical events, and the discipline of mechanics, grounded in the operation of mechanical instruments that effect tangible results in the physical world. According to the logic that yokes them together so frequently in the latter half of the sixteenth century, mechanics and politic history are allied in that both disciplines investigate the human manipulation of the material world.

Machinery also provides a conceptual and material framework for Renaissance culture to dissect and modify its vexed relationship to subtlety, a term whose diverse uses expose the culture's persistent triangulation of mechanical, intellectual, and political artifice. A number of late sixteenth-century authors of treatises on mechanics employ the term *manganaria* to describe mechanical artifice. In his 1593 *Institutionem Mathematicarum*, Conrad Dasypodius defines mechanics as an "ars Manganariorum instrumentorum," or the art of manipulating appearances by means of instruments.[8] Etymologically linked to the Greek terms *magus* and *magganon*, or deceit, the term *manganaria*, also used by Alessandro Giorgi and Bernardino Baldi in their translations of Hero of Alexandria and pseudo-Aristotle, reflects the degree to which machinery is recognized as a model for human artifice and contrivance.

Machinery mediates some of the most urgent political and intellectual problems vexing humanistic culture. Yet machines are also mediators in the most literal sense of the term insofar as they intercede between the external world and the subjective experience of the human intellect or the senses. Many of the machines analyzed in this book – speaking tubes, optical instruments, the printing press – are mediating devices that alter or interrogate our received experience of the external world. In doing so, these machines create a heightened awareness that the faculties of sense and intellect are themselves mediating instruments that perform their functions with varying degress of success. Galileo and Bacon both look to mechanical instruments as a way to transcend the errors and limitations of the senses, but they are also aware that machines, like the "uncertain light of the sense" and the imagination, distort the information they transmit. Bacon thus compares the mediating faculty of the human intellect to an enchanted glass or an "uneven mirror" in that it "distorts the rays of things" when it

"treacherously implants and mixes its own nature into the nature of things" unless reduced by methods. That machinery mimics, rather than corrects, the errors and vanities of our sensual instruments is a central problem in Bacon's natural philosophy, one echoed by many Renaissance writers as they study mechanical objects as meditations upon the uncertainties of human experience, from the unreliability of the senses to the wayward nature of the passions.[9]

Renaissance treatises on natural magic, as well as works of literature and art, are replete with these "enchanted glasses," machines that imitate, supersede, or travesty the senses. Alternately viewed as agents of truth and as instruments of deception, these machines compound and transform Renaissance culture's concerns about mediation rather than eliminate them. Because they foreground the intermedial nature of human knowledge and interaction, machines provide a theoretical tool kit for Renaissance culture to analyze non-mechanical forms of mediation, from translation and rhetoric to diplomacy and the art of perspective. As metaphors in political and literary texts, machines redefine the moral and epistemological ramifications of instrumentality – the use of human, mechanical, or intellectual instruments to achieve a particular end. Not only do machines materially transform the mediatory capacity of our sensual faculties, but they also participate in refashioning relationships between human beings and their instruments, from readers and their texts to rulers and servants. Yet even as machinery promises to compensate for the defects of our natural instruments, these auxiliary sources of power upset confidence in the instrumentalities of Renaissance culture by threatening to arrogate or replace their natural counterparts.

The enthusiastic yet qualified interest in machinery during the sixteenth century is the product of a revolution in method taking place in natural philosophy but also in logic, law, and politics.[10] In the process of rebelling against traditional codifications of knowledge and replacing them with new intellectual methods, humanists look to machinery as both a master metaphor and a model for these new techniques. For Bacon, the correspondences between mechanical and intellectual techniques are all-pervasive, and Bacon is one of many Renaissance writers who assimilates machinery and mechanism to a corresponding group of intellectual and political strategies of subtlety or dissimulation. Yet the project of establishing correspondences between mechanical and intellectual methods proves perilous for Renaissance humanism, either because human beings do not behave like machines, or because – as Edmund Spenser ultimately admits – we should not behave like them. Humanism and its machines are thus engaged in a

series of ongoing struggles, for as strenuously as Renaissance writers attempt to accommodate machinery to their habits of thought, machinery resists that accommodation, alternately exalting and annulling the culture's most cherished values and its most precarious beliefs.

This book is not a history of mechanics per se, but rather a study of the ideational role that machines play in sanctioning or condemning instrumentality and artifice. It evolved from the perception that, before the advent of a systematic mechanical philosophy in the middle of the seventeenth century, there was a fascination with mechanical devices in Renaissance culture that had not been adequately explained by historians of science. Perpetual motion machines, hydraulic garden machinery, and automata, while failures or oddities to the scientist's eye, assert their importance through their interplay with some of the period's most conventional discourses and practices, including theatrical spectacles, moral philosophy, and portraiture. The role played by machinery in courtly or humanistic settings, moreover, cannot be understood by tracing the scientifically sanctioned roles that some machines come to play towards the end of the seventeenth century. For several decades after their invention, telescopes remain earthbound, tools for reading letters surreptitiously. Hydraulic pumps supply not steam engines but rather the mechanisms generating the wetting sports of the Renaissance garden, items similar in design to their descendants but radically different in the cultural work they perform.

Historians have frequently characterized the intellectual climate of late sixteenth-century Europe as one preoccupied with technique. Exemplified by a passion for difficulty and by a penchant for artful display, the academic and courtly cultures of Elizabethan and Jacobean England nurture virtues including ingenuity, dexterity, and grace through the mastery of mechanical devices. Recent work by R. Malcolm Smuts, Steven Shapin, and Hélène Vérin has illustrated how scientific practices participate in the cultivation of intellectual virtuosity during the period. According to Smuts, John Dee, Salomon de Caus, and Prince Henry were all fascinated by "mechanical gadgetry," and each sought to forge a "philosophy of artificial works" in which mechanics contributes to a reformulation of the relationship between art and nature.[11]

Yet in spite of the era's obsession with technical skill, or with what sixteenth-century writers often call method or practice, there is no such thing as technology before around the middle of the seventeenth century. While there are many texts depicting mechanical devices, there is little if any categorical distinction between mechanics and other intellectual disciplines.

In an era preoccupied with the classification and arrangement of knowledge, objects which from our contemporary standpoint appear to belong to a discrete category cannot predictably be located in any particular place. Descriptions of mechanical objects often surface where a text's organization falters, under miscellaneous headings such as "Ludicra," "Extravagants," or even "Chaos" (in Guido Pancirolli's 1599 *De Rerum Inventoribus*, John Bate's 1634 *The Mysteryes of Nature and Art*, and Giambattista della Porta's 1589 *Magia Naturalis*, respectively). Furthermore, discussions of mechanics may seem trivial in context: Porta's descriptions of optical instruments and pneumatic machinery appear alongside recipes for hair dye and instructions for tattooing. Yet, as Patricia Fumerton has shown in her *Cultural Aesthetics*, the incidental and the peripheral are often deceptively central, foregrounding Renaissance culture's most acute anxieties and problems.[12] Some of the objects analyzed in this book may well be marginal in that they fall beneath the threshold of scientific legitimacy, but it is the very marginality of Renaissance machinery that allows it to infuse the culture's habits of thought.

When I do refer to *technologia* or technology, a term which first appears in English in around 1615 and in Romance languages slightly earlier, I use it in the capacious, sixteenth-century sense discussed above. The term "natural magic" more closely approximates the modern use of the term "technology" in that it signifies procedures that appear supernatural but are in fact produced by natural means. Yet even this latter term is unsatisfactory in that it fails to capture the mutual permeability between mechanics and other intellectual disciplines or the interplay between mechanical and non-mechanical objects as shown by Horst Bredekamp's study of the logic governing the arrangement of Renaissance *Kunstkammern*, in which machines, natural curiosities, and artifacts are placed side by side to demonstrate and alter the continuum between art and nature.[13] Both inside and outside the *Kunstkammer*, Renaissance culture correlates machinery to non-mechanical objects and practices rather than constitutes mechanics as a separate discipline. Instead, machinery lurks in the interstices of the Renaissance imagination: its meanings are formed out of an interplay with the culture's aesthetic and political sensibilities and its philosophical dilemmas.

Circumscribing a scope of study for a field that defies disciplinary boundaries has proven challenging. The sketches of engines made by artist-engineers such as Leonardo Da Vinci and Francesco Di Giorgio Martini certainly qualify as machinery, but what about the fantastic caricatures of Giuseppe Arcimboldo or François Desprez, human figures composed out of kitchen implements, compasses, and bellows? A treatise on an astronomical

instrument such as Thomas Hood's 1590 *The Use of the Jacob's Staffe* surely constitutes a work of mechanics, but how might one categorize Thomas Blundeville's 1594 *Exercises*, an anthology of texts on cosmography and mechanics that asks its gentlemanly audience to view such "exercises" as the intellectual ornaments of the Elizabethan courtier?

It is thus difficult and even misleading to distinguish mechanical and non-mechanical treatises from each other on account of their shared idioms and their overlapping intellectual aims. The difficulty of carving out a disciplinary identity for machinery during the period is compounded by the manifold resonance of Renaissance culture's mechanical vocabulary. The use of terms such as "engine," "device," "motion," and "instrument," as well as "subtle" and "artificial," demonstrates that machinery belongs to a larger semantic network which includes in its purview any witty device from an emblem or an epigram to a morsel of political advice. A 1590 translation of Francesco Sansovino's *Quintessence of Wit*, a collection of "conceits," "maxims," and "poleticke [*sic*] devises" originally composed in 1578, offers the heading "artificiall devises" for Machiavellian adages such as "it is necessary to be a fox, to know how to discypher snares."[14] Authors of technical treatises provide different offerings in similar packages: Cyprian Lucar promises "profitable devises" such as "strange engines" to the artificer who reads his 1590 text, while a 1594 treatise written by Hugh Plat and dedicated to the Earl of Essex offers "artificiall conceipts" and "ingenious devices," including optical instruments and self-moving plows, to a patron expert in political devising.[15]

This network of terms and techniques affiliated with Renaissance machinery is indebted to the ancient Greek concept of *metis*, that "complex but very coherent body of mental attitudes and intellectual behaviour[s]" whose semantic and cultural range is traced by Marcel Detienne and Jean-Pierre Vernant in their *Cunning Intelligence in Greek Culture and Society*.[16] During the Renaissance, machines are commonly perceived to cultivate faculties of *metis* or cunning. Detienne and Vernant define *metis* adversarially: it is the "opposite" of force, consisting of any technique or method of a "different order" from strength that enables "the weaker party" to "reverse the natural outcome of [an] encounter and to allow victory to fall to the party whose defeat had appeared inevitable."[17]

Often, but not always, regarded by Renaissance writers as a species of *metis*, machines embody the cunning and subversive tactics of the weak. In his preface to Henry Billingsley's 1570 translation of Euclid's *Elements*, John Dee uses the term "Menadrie" to refer to the capacity of mechanics to produce effects "above Natures Vertue and power simple."[18] As the

means by which "Vertue and Force may be multiplied," Dee's concept of "Menadrie" characterizes mechanical power as auxiliary and compensatory in that it enables the triumph of the weak over the strong. Like many of his contemporaries, Dee adopts the pseudo-Aristotelian *Mechanical Problems'* definition of a machine as the means by which "the less master the greater, and things possessing little weight move heavy weights."[19]

The political and social ramifications of this definition of machinery are recognized and exploited by a number of Renaissance writers including the fifteenth-century humanist Giovanni Tortelli. In his 1471 *De Orthographia dictionum e graecis tractarum*, the future Vatican librarian provides a commentary upon the term *horologium* that reveals the extent to which machines enact and reconstitute the classical concept of *metis*. Tortelli begins with a historical account of the clock but soon embarks upon a digression contrasting the arts of hunting and fowling, the latter of which involves the use of night owls (*noctua*) and screech-owls (*ulula*) in order to pursue other birds. Fowling differs from hunting, Tortelli writes, in that "one uses cunning, the other violence [hoc insidiosum: illud violentum]," and that "the one works secretly, the other in the open [hoc ex occulto: illud ex aperto]."[20]

By contrasting the different techniques required by hunting and fowling, the former employing open force and violence, and the latter cunning and secrecy, Tortelli's digression invokes a conflict between natural and artificial power of paramount concern to Renaissance culture, particularly with respect to the growing material and discursive presence of machinery. Tortelli's contrast between the two practices reflects his culture's more widespread ambivalence towards artifice which manifests itself in the continual and pervasive examination of whether it is better to hunt or to fowl – to do things openly and directly, or to do them covertly and indirectly. By providing new models of cunning, machinery shapes this diacritical preoccupation with instrumental means, often prompting a reappraisal of the aesthetic and moral doctrines according to which Renaissance writers either sanction or condemn artifice.

Like more classic expressions of guile such as fowling, which relies upon birds that only emerge at night, Tortelli argues, the clock "speaks to us even when the sun is hidden [sed et occultato sole sermo]," and is thus able to circumvent the limits of nature. But it is Tortelli's final distinction between hunting and fowling that underscores the entry's latent yet pervasive antithesis between force and subtlety and drives home its sociopolitical implications. While hunting is the preserve of the wealthy, fowling is practiced by commoners, confirming what "Aristotle and others have written, that it is the nature of the poor . . . to employ trickery, and of the rich to

employ force: and so the former are compared to little foxes [*vulpeculae*], the latter to the lion." With little recourse to more direct expressions of power, the poor instead assume the slyness (*dolos*) of a fox, the creature whose brand of *metis*, according to Detienne and Vernant, exemplifies how "the cunning [*techné*] of the weaker" can take the stronger by surprise and bring about his downfall.[21]

Renaissance machines enact precisely such reversals of power. Drawing from the pseudo-Aristotelian *Mechanical Problems* and from Book 10, chapter 1 of Vitruvius' *De Architectura*, sixteenth-century natural philosophers define mechanics as an art beyond the power of nature that enables the lifting of heavy objects with minimum effort: "qua magna pondera, machinis adhibitis, praeter naturam, in altitudinem tolluntur: minori potentia."[22] In the engine-houses of Bacon's *New Atlantis*, instruments are made to perform tasks "more easily, and with small force, by wheels and other means," thus reinscribing ancient narratives of *metis* in which the weak master the strong with the help of *techne*.[23] Not all machinery, however, is understood during the period as a tool of *metis*: in the hands of monarchs or aristocrats, machines can reinforce absolutist political structures or exclusionary marks of social distinction. Yet even in the context of the Renaissance court, machinery can accrue meaning as a compensatory power insofar as it exemplifies the conquest of difficulty, or *sprezzatura*, cultivated by the Renaissance courtier as a means of hiding defects or outstripping rivals.

Renaissance dictionaries confirm the adversarial capacity of mechanical power by defining terms such as "machine," "engine," and "device" as synonymous with fraud, cunning, and other non-mechanical forms of power that work by deception or obfuscation rather than by force. Randle Cotgrave's 1611 French–English dictionary defines *engin* as a "toole" or "instrument" but also as "understanding, policie, reach of wit; also suttletie, fraud, craft, wilinesse, deceit." In the same year, the first edition of John Florio's Italian dictionary defines the Italian *ingegno* as wit, engine, art, skill, or cunning, and the 1659 edition, revised largely before Florio's death in 1625, refines the existing definition of the term by adding that *ingegno* also means "any kind of engine, machine, frame . . . or any water-works." Two of the earliest dictionary appearances of the term *technologia*, in Guillaume Budé's 1529 *Commentarii Linguae graecae* and in the *Lexicon Graecolatinum* of Jean Crespin, first printed in Geneva in 1562, define it as the art of verbal artifice: as "de arte dissero" and (in Crespin) as "sermo & ratiocinatio de arte, artificiosa ratio."[24] Linked semantically and morally to the realm of imposture inhabited by Spenser's Malengin, Jonson's Subtle, and the stage Machevill, mechanical devices participate in and alter the culture's