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The *Trattato* as Textbook: Francesco di Giorgio's Vision for the Renaissance Architect

Elizabeth M. Merrill*

In fifteenth-century Italy, the architect's role lacked definition. The classical conception of the architect — the distinguished professional lauded by Vitruvius and Cicero, as theoretically versed as he was technically skilled — had faded in the medieval period. Even the term '*architectus*', with its powerful connotations of creation and authorship, had fallen out of use (Kostof 1977: 60–61). Furthermore, there was no standard of training or apprenticeship for the architect. Depending on the context, the engineer, carpenter, patron, or building administrator might be considered the building's architect (Hollingsworth 1984: 385–410). On the role of the architect in the Italian Renaissance and the development of an architectural profession, see Ackerman 1991, Ettlinger 1977, and Wilkinson 1977. But beginning around 1400, numerous artists, scholars, and patrons began to express the need for an established architectural profession. Multiple contemporary accounts — architectural treatises, biographies, municipal archives, and building patents — give voice to the mounting dissatisfaction with current building processes and the role of the architect. Jacopo Mariano Taccola recorded Filippo Brunelleschi's complaints about the lowly status of the architect-inventor, whose ideas were commonly stolen or misattributed (Prager and Scaglia 1970: 125–130). The Florentine goldsmith Lorenzo Ghiberti vowed to write a tract which would explicate the principles of superior *all'antica* architecture, but never did (Krautheimer 1956: 256, 311). And while Ghiberti never completed his treatise, Leon Battista Alberti and Antonio Averlino Filarete each wrote one. Although distinct from one another in form and content, Alberti's and Filarete's treatises both address the architect's lack of authority, and the consequential delay or failure to complete building projects. Similarly, Federico da Montefeltro and Antonio Manetti left records that espoused the eminence of the architect, and expressed the need to restore the profession according to the ancient model (Manetti 1970; Montefeltro 1978: 19–22).

The *Trattato di architettura* of Francesco di Giorgio Martini (1439–1501) was one of the many voices within this debate, and as the first Italian, fully illustrated tract to pro-vide a proscriptive approach to architecture, it was revolutionary. Francesco conceived of the treatise as a manual for the aspiring architect, and because there was no adequate model for this type, he had to create a new format. His project for the *Trattato*, which he drafted, wrote, and re-wrote between 1475 and 1495, became a career-long endeavor. Filled with practical guidance and theoretical exempla, the *Trattato* defined architecture as a scientific discipline, rooted in arithmetic and geometry, and realized through drawing (*disegno*), creativity (*ingegno*) and invention (*invenzione*). The architect, according to Francesco, is an artist, inventor, and technician, and only earns his title after years of study and on-site training.

This article uses Francesco di Giorgio's conception of the architect, as outlined in his *Trattato di architettura*, as a lens through which to examine the emergence of the Renaissance professional architect. I do not claim that Francesco's vision for the architect was absolute. On the contrary, his was only one, albeit highly influential, model in this period of burgeoning art and architectural theory. Leon Battista Alberti's *De re aedifactoria* was regarded by many of Francesco's contemporaries as the preeminent architectural theory. Francesco was certainly familiar with Alberti's eloquent tract, and I argue that the final version of the *Trattato* was composed as a rebuttal to the then newly printed *De re aedificatoria* (1485). For Francesco, Alberti's impractical theory of architecture — which focused on beauty and the building concept, and barely touched upon the practical aspects of construction — did little to help define the profession's already ambiguous contours.

Francesco's concern with the processes of building design and construction found great resonance with practicing architects. Reproduced in hundreds of manuscript copies, the *Trattato* was a standard reference manual in late-fifteenth-century Italy, and as debates on the architectural profession continued into the sixteenth century, Francesco's treatise served as a model for a handful of new, practically oriented treatises. This is exemplified in the tracts of Baldassare Peruzzi and Pietro Cataneo, both of whom, like their distinguished Sienese predecessor, invested in architectural education and sought to compose tracts for the working architect. Although Francesco's vision for the architect never became the undisputed norm, his prescription for the architect-technician was formative. The *Trattato di architettura* was a practitioner's

*University of Virginia, United States
emm2z@virginia.edu

treatise, and by its widespread dissemination and use, came to define an entire generation of working architects.

The genesis of Francesco's *Trattato di architettura*

The *Trattato di architettura* was born out of Francesco's early years of architectural training in Siena. His pocket-sized notebook of mechanical copy-drawings and design prototypes, the so-called Vatican *Codicetto*, reflects his early proclivity to compile exempla.[1] As Francesco matured as an architect, and continued to expand his knowledge of building practice and theory, he became increasingly aware of the need to systematize what amounted to an overwhelming amount of information. But he did not want to limit architecture to a set of rules. Instead, he saw his role as a 'motivator' (*motore*), providing a theoretical framework for other 'more sublime and virtuous minds' (Martini 1967: 298).[2] On several occasions in the treatise he refers to those 'ignorant' (*ignoranti*) individuals who falsely call themselves architects without knowing the principles of the discipline (Martini 1967: 298, 373, 412, 493). Francesco recognized that for architecture to progress, and to be considered among the *artes liberales*, it needed theory. Between 1475 and 1495 he pursued this end, continually editing and modifying his *Trattato di architettura*. He wanted to produce not merely a reference guide, filled with facts and exempla, but a tract that would define architecture and teach architects how to think more critically about their discipline. For a comprehensive review of Francesco di Giorgio's architectural theories, see Betts 1971.

In total, Francesco completed at least four distinct drafts of the *Trattato di architettura*, which scholars today recognize in two principal versions.[3] The first version (c. 1478–1481, hereafter *Trattato I*), is exemplified in the codex Ashburnham 361 (Biblioteca Medicea-Laurenziana) and the slightly later codex Saluzziano 148 (Biblioteca Reale, Turin). The second version (*Trattato II*) dates between 1487 and 1500 and is known in the codex S.IV.4 (Biblioteca Comunale, Siena) and the codex Magliabechiana II.I.141 (Biblioteca Nazionale Centrale, Florence). *Trattato I* is organized as an eighteen-book survey of architecture, covering a range of building types and topics relevant to construction. Drawing heavily from Vitruvius' *De architectura* and Taccola's *De ingeneis*, texts Francesco had studied during his formative years in Siena, *Trattato I* reads like an objective synopsis of the individual components of architecture (Scaglia 1991: 61–66). Francesco's prose is succinct. He gives only a handful of examples and makes few references to his own experiences. In parts, the text proceeds almost like a catalog, with a disproportionate number of sentences beginning with 'and' or 'also'.[4] The great strength of *Trattato I*, however, lies in its drawings. On nearly every folio lucid images are paired with the text, illustrating each of the tract's core concepts. The unschooled architect could gain as much from the figures as he could from the commentary. For instance, for his discussion on façade compositions Francesco offers elevations with overlaid ruled lines, which clearly demonstrate the proportional relationships between the apertures and moldings.[5]

Francesco composed, and then systematically edited, the second version of the treatise (*Trattato II*) following fruitful tenure as court architect in Urbino. In addition to his continued work as court architect, he had designed the church of Sta. Maria delle Grazie al Calcinaio in Cortona and the Palazzo della Signoria in Jesi. He had also traveled south, possibly consulting with the Duke of Calabria Alfonso II on the fortifications in the kingdom of Naples, and had examined the ancient ruins in Rome and Campagna.[6] Francesco also experienced considerable intellectual growth in this period. Utilizing the resources of the Urbino court library, he read medieval and ancient philosophy, and with the aid of a humanist advisor, returned to his study of *De architectura*.[7] Although not without errors, Francesco's translation of *De architectura* — the first vernacular version of the notoriously difficult text — was progressive. The project required not only a strong grasp of Latin, but also an astute knowledge of technical terminology and the history of ancient architecture and mechanics (Martini 2002: xx–xxi).[8]

The second version of the *Trattato*, although similar to the first in terms of content, is substantially different in organization and tone, and here Francesco's didactic intent becomes more evident. Francesco presents himself as a scholar and upmost authority, incorporating his updated translation of Vitruvius, as well as extracts from the writings of Aristotle, Cicero, Plato, and Pliny the Elder, among others. In contrast to the eighteen disjointed and, at times, repetitive books of the first version, *Trattato II* consists of seven books, and follows an Aristotelian model of 'causes' or 'first principles'. Each book begins with the general — man's need for communal urban structure, for example — and proceeds to the particular — how the streets should be arranged, where the shops are to be located, and how the city plan should respond to its natural environment.

Francesco's presence is also more dominant in *Trattato II*. Writing as if speaking directly to his pupil, Francesco routinely supplements his arguments with his own experiences and expertise, assuring the reader that his principles, although grounded in classical theory, hold true in modern practice. For example, whereas in *Trattato I* he spoke only in general terms, in the second version, he uses the fortresses he built in the duchy of Urbino as models (Martini 1967: 459–464). Similarly, in the latter version, Francesco shares his experiences as hydraulic engineer, his study of antiquities, and his extensive knowledge of natural resources. In tone, *Trattato II* is more commanding and insistent, as manifest in Francesco's repeated use of the imperative 'must' (*dovere*). In contrast to the earlier version, where his principles read like suggestions, in the final treatise, Francesco resolutely asserts what the architect must do: he must understand materials, he must use drawing, he must design the fortress according to the appropriate specifications.

Francesco's systematic editing process of *Trattato II* is evident in the comparison of the two principal copies. The Siena codex, a small, roughly executed copy, is an early draft of the second version. The manuscript has few illustrations, but contains marginal annotations that refer to

Fig. 1: Anonymous, copy-drawings from Francesco di Giorgio's *Trattato di Architettura* Codex 10935, Österreichische Nationalbibliothek, Vienna (c. 1530). Folio 135r: Cut-out illustrations of *camini*. Pen and ink on paper.

Francesco's canonical images — presumably recorded in another manuscript — and indicate where they were to be placed in the final copies. The Siena codex was then further modified, serving as the basis for the final version of the *Trattato*, as exemplified in the codex Magliabechiana. The fully illustrated Magliabechiana *Trattato* is bound together with Francesco's autograph translation of Vitruvius and a copy of his *Raccolta* of machine designs, suggesting its provenance within the architect's workshop. This manuscript served as a prototype for numerous secondary copies, and because of its polish and clarity, it has been suggested that the codex was assembled with the intention of publishing a comprehensive, three-part exposition on architecture (Fiore 1978: 76).[9]

Although it is unclear where or how the copies were produced — in a scriptorium, by independent copyists, or within Francesco's workshop — Francesco undoubtedly initiated the copy and diffusion of the *Trattato*.[10] The quantity of copies in circulation, and the systematic process by which they were produced, makes it unlikely the tract was released without the author's permission. Yet because the tract was never printed, the contents remained subject to the copyist's discretion. Reproductions of the treatise range from complete, fully illustrated manuscripts, to partial copies with limited text, to variously modified versions with substitutions and additions. Each copy, between approximately fifty and one hundred folios in length, was composed by two or more hands and produced according to demand.[11] A scribe would first transcribe the text, leaving spaces where an artist or illu-

minator would later add the images. As is evident in the codex Beinecke 491 (Beinecke Library, New Haven) and the codex Ital. IV 3–4 (5541) (Biblioteca Marciana, Venice), it was also not uncommon for the scribe to paste images into the margins. Drawings of this type, true stock illustrations, suggest the larger-scale production of *Trattato* manuscripts. An artist would trace the original illustrations *en masse* onto full sheets of paper, cut them into strips, and then insert them into the manuscripts (Scaglia 1992: 180). The unused images, which came to be intermixed with the workshop drawings, were occasionally added to miscellaneous copybooks, such as the codex Ashburnham 1828 (Biblioteca Medicea-Laurenziana, Florence) and the Album codex 10.935 (Österreichische Nationalbibliothek, Vienna) (**Fig. 1**).[12]

Francesco's model architect

Francesco presents his vision for the Renaissance architect in his *Trattato II*. Opening the tract with an invocation of the mathematician Eupompus of Macedonia, a figure highlighted in Pliny the Elder's *Natural History*, Francesco characterizes architecture as a scientific discipline, rooted in arithmetic and geometry, and realized with drawing (*disegno*), creativity (*ingegno*) and invention (*invenzione*) (Martini 1967: 293–294). Citing Aristotle, he explains that art follows nature, and accordingly, the architect bases his designs on the underlying order of the natural world (Martini 1967: 294). To truly understand building, the architect must examine its essential causes, which are revealed only through direct experience. By using Aristote-

lian philosophy as a framework for his discussion on architecture, Francesco presents the discipline as an objective, empirical science, a 'final cause' created for the 'utility or glory of man' (*alcuna utilità o gloria all'uomo*) (Martini 1967: 301).[13] A complete understanding of architecture, he teaches, involves knowledge of its physical components (the material causes), the construction processes and building forms (formal causes), and the work of the architect (the efficient cause), and it is to these subjects that Francesco devotes most of his attention. The *Trattato* concerns the fundamental qualities of architecture —the different types of stone, defensive schemes, commodious house plans, and building machinery — and tellingly, says little about ornament.

Francesco's conception of architecture was greatly colored by Vitruvius' *De architectura* — the definitive source on ancient architecture — and Jacopo Mariano Taccola's treatise on engineering, *De Ingeneis*. Following Vitruvius, Francesco adopted a liberal definition of architecture. Francesco's theory, like that given in *De architectura*, develops around the core concepts of *ordinatio* (order), *dispositio* (arrangement), *eurythmia* (proportion), *décor* (decorum), and *symmetria* (symmetry). As Francesco aptly demonstrates in the *Trattato*, these broad principles are applicable to a range of building types — civic, residential, ecclesiastical, and mechanical. In this, Francesco's adherence to the Vitruvian conception of the primacy of machine design is particularly remarkable (Pagliara 1986: 24–25). Rather than scornfully dismissing mechanics, as was common in the fifteenth century, he appeals to an ancient model of mechanical excellence. Distinguishing the theoretically and geometrically rigorous work of the mechanical engineer from that of the common laborer, Francesco echoes Vitruvius in his assertion that without machines, great building is impossible (Rowland 2002: 245–259; Wilkinson 1988: 467–474).[14]

Francesco's understanding of architecture as a discipline, a mode of practice grounded in theory and realized through continuous education and manual practice, also derived from Vitruvius. On the education of the architect in Book I of *De architectura*, a passage Francesco ingeniously parrots in *Trattato I*, the ancient author speaks of architecture as a lifelong commitment. The practitioner, he states, must start young, climbing step by step to reach the pinnacle of architectural excellence (Book I.1; Vitruvius 1999: 23). Although Francesco does not quote Vitruvius on the architect's education in *Trattato II*, he remains emphatic that the architect's success derives from on-site experience. This is perhaps most evident in Book V, on 'The Form of Castles and Fortresses', in which Francesco discloses the degree of technical dexterity and practical judgment (*iudicio*) he expects of the architect. Throughout the lengthy explication, Francesco repeatedly assigns his reader — the practicing architect — the task of selecting the fortification site, determining the plan, and working out the component details. At the end of his discussion on boundary walls, for example, he states: 'And now, enough has been said, because the prudent and expert architect, who has knowledge of many parts of the rules and examples, may adapt and apply these according to the site, adding, subtracting and composing' (Martini 1967: 456).[15] Similarly,

on the subject of fortified bridges, he asserts: 'These may be made in infinite and various inventions according to the intelligence of those who are practiced (*sono eserciati*) in such exercises (*tali esercizi*)' (Martini 1967: 444).[16] His repeated use of *esercitare* — to exercise, operate, conduct, or practice — further underscores his belief that the architect must learn through doing, training himself on the site, to gain the ability to invent and design on his own.

But Francesco did not accept Vitruvius' theory in full. Whereas *Trattato I* paraphrases long passages from *De architectura*, the second version is more judicious in its citations. Francesco recognized that Vitruvius wrote in a different age, and that on certain points his commentary was overly idealistic, if not entirely obsolete. *Trattato II* does not repeat Vitruvius' extreme notion of the architect as encyclopedic polymath, nor does it promote the Vitruvian image of the architect as a figure of exemplary morality, who never petitions for commissions, cares little about his pay, and works solely for his love of the profession. Rather, Francesco acknowledges the commercial aspects of building, and speaks frankly about the architect's desire for fame. Finally, Francesco's approach to building proportions and the columnar orders is far less dogmatic than that of the ancient author. Although Francesco, like Vitruvius, advocates for a geometric, modular approach to architecture and believes that building proportions should refer to those of the human body, unlike Vitruvius he does not prioritize the architect's use of exact proportions (Book VI.2; Vitruvius 1999: 78).

On the contrary, Francesco's theory emphasizes flexibility and invention. The *Trattato* does not espouse a fixed canon of columnar orders, nor does it present a codified system of building. Rather, the tract teaches that as long as the architect adheres to the essential geometrical forms and balanced proportions, he may adopt and modify his plans as he sees fit. Architecture, Francesco notes, 'like all the other sciences, is being continuously formed, with each [discovery] adding to the next'. The final design is not to be determined by rigid guidelines, but rather 'according to the infinite invention that occurs in the mind of the architect' (Martini 1967: 372–373).[17] Francesco's conception of the architect-as-inventor derived from Mariano Taccola (1382–1453), the fabled 'Archimedes of Siena', whose treatise *De Ingeneis* (1428–1441) he scrupulously studied. A distinguished artist, engineer and scholar, Taccola sought to devise machines of greater speed, power, and efficiency, and believed that without experimentation, progress was impossible. To this end, he assembled his *De ingeneis* as the ultimate idea-book of mechanical designs, overflowing with thousands of study drawings of hydraulic structures, gear-shafts, construction machinery, and military devices. Here, one sees how in practice, Taccola equated invention with drawing and variation. Folio 60r of Book I, for example, shows Taccola repeatedly returning to the same concept, each time modifying and reinventing his original design (**Fig. 2**). These studies — too cursory to serve as definitive models — were the inventor's ideas, suggestions for further investigation, and inspiration for new designs. As Taccola notes, 'many things occur in the course of work that the architect or worker never planned'. Thus, the architect, a man gifted with 'per-
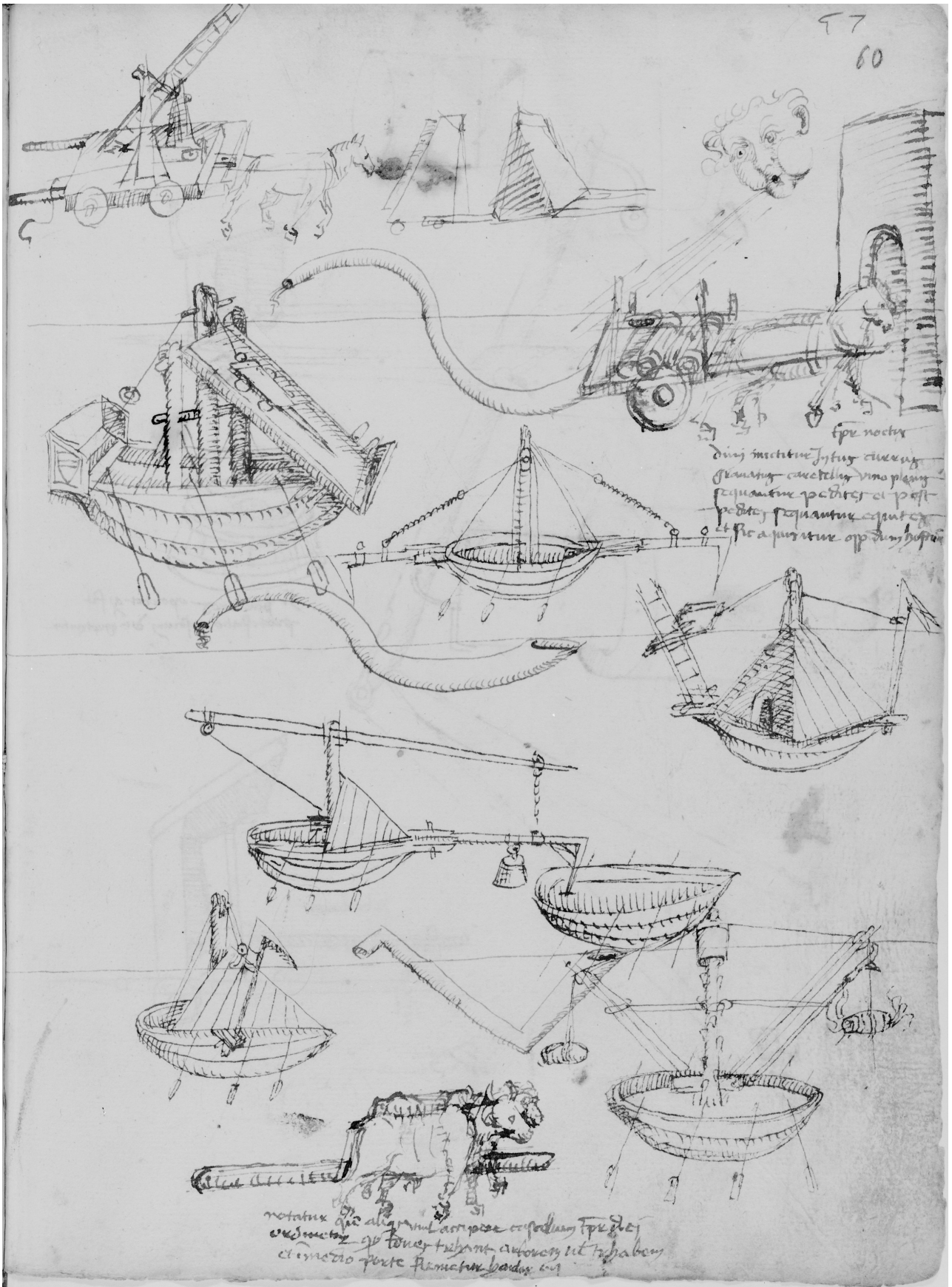
Fig. 2: Jacopo Mariano Taccola, *De ingeneis*, Book I. Codex Latinus 197, Bayerische Staatsbibliothek, Munich (c. 1427–1440). Folio 60r: Mixed sheet with studies for vessels for marine warfare. Pen and ink on paper, 30 x 22 cm.

spicacious ingenuity' (*prespicaci ingienio*), must have the preparation and experience to adopt the designs according to his own project (Prager and Scaglia 1972: 98–99).

In developing the *Trattato*, Francesco took much from Taccola. He used *De ingeneis* as a source of mechanical designs and copied long sections of Taccola's textual

commentary (Scaglia 1991: 64–66). From Taccola, he also adopted a theoretical approach to architecture that privileged technical innovation. Like his Sienese predecessor, Francesco understood the architect to be a technician, responsible for the building's overall form, as well as its stability, and the processes of its construction. By this view, the design of complex, mechanical structures, such as devices for lifting great weights, water pumps, and urban defenses, were among the architect's pinnacle achievements.[18]

But perhaps the most important thing Francesco learned from Taccola was the paramouncy of *disegno* — a term he used to designate both the processes of composition and the expression of ideas through drawings. Expanding on the thin commentary offered in *De ingeneis*, Francesco's theory offers a more methodical, philosophically astute analysis of architectural *disegno*, sagaciously linking it to the concepts of *ingegno* and *invenzione* in a conceptual framework unparalleled in quattrocento theory (Kemp 1977: 350–353). According to Francesco, *disegno* is not only a mechanical practice, but also a rational process of imagination and invention, closely tied to cognition (*cognitatio*). The architect who works with drawing, Francesco tells his reader, develops creative dexterity, and by means of invention, cleverly arrives at an original and effective design solution (Martini 1967: 483–484).[19] Paraphrasing Aristotle, he explains that the efficacy of *disegno* as a means of expression is directly related to the primacy of vision among the senses. Images are more easily comprehended by the intellect and are more memorable than text (Martini 1967: 444–445).[20]

Francesco's theory of architecture, therefore, philosophically framed in terms of first causes, is essentially practical, and he wrote the *Trattato* with the practitioner in mind. Notably, the text makes no distinction between theory and practice. In Francesco's view, the practicing architect requires theory, as the discipline itself is grounded in a set of theoretical principles. In defining these principles, and by extension, the role of the architect, the *Trattato* provides a new schema for the discipline.

Francesco vs. Alberti

Francesco's dissatisfaction with the existing practice of architecture was the driving force that pushed him to write, and re-write, his *Trattato di architettura*. The treatise, he recognized, might not only give contours to the diffuse discipline, but also help elevate the status of the working architect. However, Francesco's work as a theorist was by no means selfless, nor was his dominant presence in *Trattato II* incidental. As discussed previously, by featuring his experiences so deliberately in the final version, Francesco emphasized his own authority and expertise. In this, he also sought to distinguish his theory from those of his predecessors and peers. Most of all, Francesco wanted to differentiate himself from Leon Battista Alberti.

Francesco was undoubtedly familiar with Alberti's *De re aedificatoria*, if not before its 1485 printing, certainly after, and his decision to re-write the *Trattato* in the late 1480s was arguably motivated by the publication of the Florentine's treatise.[21] Reading Alberti's eloquent text, possibly with the assistance of one of the many humanists in residence at the Urbino court, Francesco must have recognized the inadequacy of his *Trattato I*. Among the cultural elite, *De re aedificatoria* was hailed as a masterful rhetorical piece, a seamless textual composition, which combined Alberti's extensive knowledge and erudite observations with dozens of literary exempla. Moreover, following its publication, it was now more readily available, well positioned to become the definitive treatise on *all'antica* architecture. Humanists like Cristoforo Landino and Angelo Poliziano lauded Alberti as the consummate Renaissance architect, and powerful patrons, including Borso d'Este, Matthias Corvinus, and Lorenzo de' Medici treasured *De re aedificatoria* as the modern bible on *all'antica* architecture (Alberti 1972: 143; Alberti 1988: xviii–xix). Architects also fell under the sway of Alberti's celebrity. In his *Libro architettonico*, Filarete repeatedly cites Alberti as a known authority on matters of art and architecture (Filarete: 640–642). Similarly, in his *Vita* of Brunelleschi, completed shortly after the publication of *De re aedificatoria*, Antonio Manetti hails Alberti as the new Vitruvius (Manetti 1970: 55).[22]

Francesco, however, recognized the limitations of Alberti's text. Although befitting the patron, *De re aedificatoria* was of little value for the practitioner. Not only was it inaccessible on account of its difficult Latin, but Alberti's elitist vision of the architect, Francesco believed, posed serious consequences for the future of the profession. In the Prologue of the codex Magliabechiana, Francesco makes two thinly veiled references to Alberti. He appears to have the Florentine in mind when he speaks of 'learned men' who write about painting and architecture without images, leaving abstruse books of 'little invention' (Martini 1967: 294).[23] Alberti is again implicitly evoked when Francesco comments upon the insufficiency of previous treatises on architecture:

> Although I am not unaware that some modern [writers] have written and commented on this art, yet in the end I find that they have touched lightly on useful and difficult passages. Whence, it happens that for some it seems that in a brief time this art of architecture has been rediscovered, and understood in its principles, rules and conclusions, [yet] without arrogance and bias of due reproof, one can say that all modern buildings are full of errors and that their parts lack proper proportion or symmetry (Martini 1967: 297).[24]

The *Trattato* then was intended to fill the void left open by these modern theorists, and by *De re aedificatoria*. Not only was Alberti's Latin text unillustrated, but it brushed over many of the difficult and useful aspects of architecture. By not explicitly naming Alberti, Francesco avoided the risk of directly challenging one of the period's most revered authorities, while also affirming the autonomy of his own theory.

Although Alberti's precedent provided Francesco with the impetus to develop *Trattato II*, Francesco's theory is completely different from that put forth in *De re aedificatoria*. Unlike Alberti, Francesco was not a humanist, and in prose and erudition, he did not compete with the learned Florentine. The emboldened tone he adopts in *Trattato II*, and his expanded catalogue of classical literary sources, was part of his program to assimilate the Albertian model. The success of *De re aedificatoria*, he recognized, was in large part due to the authoritative status of its humanist author. To rival this text, Francesco had at the very least to demonstrate his knowledge of the classical tradition. Nevertheless, Francesco's primary aim in writing the *Trattato* differed from Alberti's; he sought to provide an accessible, practical theory of architecture, and to this end, his credentials were far superior. Underscoring the distinctions between his theory and that of Alberti, Francesco consciously emphasizes those aspects of the *Trattato* that are absent from and antithetical to the Albertian model. It is no coincidence that he highlights the most glaring flaw of *De re aedificatoria* — the absence of illustrations — as the counter point from which to frame the *Trattato*. The architect without *disegno*, Francesco repeatedly reminds his reader, 'is nothing and often also lacks many other abilities' (Martini 1967: 506).[25]

Moreover, in terms of his actual practice, Francesco's model architect — the technician who learns through experimentation and on-site training — could not be more incongruous with Alberti's ideal. As presented in *De re aedificatoria*, the architect is a gentleman, a man of letters who distances himself from the physical processes of construction, and deals only with the 'most beautifully fitted out' structures suitable for the 'noble needs of man' (Alberti 1988: 3). The scope of architecture covered in *De re aedificatoria* — prominent residences, civic buildings, public spaces, and grand urban plans — accords with this definition of the architect. Mechanical and utilitarian constructions, which in the *Trattato* are presented as foundational to good architecture, are of little concern to the Albertian architect, who is required only to know painting and mathematics (Book IX.10; Alberti 1988: 317).[26] For knowledge on matters related to construction, Alberti advises the architect look to ancient texts rather than rely upon the 'artifice of invention' (Book II.4; Alberti 1988: 38).[27]

In stark contrast to Alberti, Francesco's theory privileges utility, focusing on the commodity (*comodità*) and convenience of the building. Francesco's exposition on the 'Parts of Houses and Palaces', for example, concerns those things that are 'useful' and 'necessary' (*utile e necessario*) for the human habitation — kitchens, chimneys, staircases, storerooms, stables, and bathrooms — subjects that *De re aedificatoria* glosses over or ignores entirely. And whereas Alberti dedicates an entire book to the ornamentation of private spaces, Francesco is quite succinct on the subject: 'Consequently, one should know that the unnecessary ornaments can take many forms — such as semi-columns, attached or independent, cornices, stuccos, figures, paintings and other modes which are developed in *disegno*, and which for me are superfluous to elaborate upon' (Martini 1967: 355).[28] This is to say that the real architect, who utilizes *disegno* and thus obtains perspicacious ingenuity, will have no trouble devising ornaments on his own. Finally, Francesco differentiates himself from Alberti by prioritizing experience over book learning. Facts and rules (*dottrina*), which many 'speculative' authors falsely believe constitute the core of architectural education, are in themselves far from sufficient. The architect, Francesco stresses, must combine *dottrina* with *ingegno* and *disegno*, abilities he hones through long practice (Martini 1967: 489–490).[29] This emphasis on the architect's practice, and his physical experience with materials and places, distinguishes Francesco's vision for the architect from Alberti's ideal. This emphasis was also what made the *Trattato* so popular among Renaissance architects.

Trattato as textbook

In content and organization, the *Trattato di architettura* is structured as a kind of architectural textbook. As the first illustrated, vernacular treatise to provide a prescriptive approach to all aspects of architecture — from materials to site conditions, methods of design, and the construction of aqueducts, churches, palaces, fortresses, and war engines — Francesco's tract was unprecedented. In the second half of the fifteenth century there was no single, immediate model for a book of this type. Illustrated technical treatises, such as those of Frontius, Giovanni Fontana, Taccola, and Roberto Valturius, provided contextual references, but as texts written for patrons, not practitioners, they served a very different function. Not only were these treatises in Latin, but the flat, undetailed illustrations gave little information about how the machines they depicted actually operated (Galluzzi 1991: 16–25). Standard primers used in artistic and commercial education, the *trattati d'abaco*, were not quite appropriate models either. Although written in the vernacular and partially illustrated, these were essentially rule-books without any foundational theory. Nor did the architectural treatises of Alberti and Filarete provide suitable precedents for Francesco's project. Alberti's and Filarete's tracts were essentially literary pieces, and failed to provide a cohesive theory, or even a standard vocabulary, for the working architect. Thus, the format Francesco developed for the *Trattato* was a hybrid — combining features of the illustrated technical treatise with the *abaco* manual and the humanist commentary. The result, a legible, straightforward tract on building, became a standard reference for generations of architects, and in the continual reproduction of its text and images, provided a new model for the working architect.

In the Italian Renaissance, the *trattato d'abaco* constituted the basic curriculum of the *scuola dell'abbaco*, an elementary commercial school where boys learned basic arithmetic, algebra, and geometry (Goldthwaite 1972: 420). *Abaco* schools, although primarily founded for the purpose of mercantile education, also provided the basic primary schooling of artists and craftsmen. Moreover, by the fifteenth century it was not uncommon to find artists and mathematicians working in collaboration, and a hand-

ful of treatises, such as Lorenzo Ghiberti's *Commentari*, Alberti's *De' ludi mathematici* and *Della pittura*, and Piero della Francesca's *Prospectiva pingendi*, demonstrate the growing attention given by artists to mathematics (Davis 1977: 1–20). Francesco, who defined architecture as a mathematically based science and formulated a design approach using geometry and quadrature, was undoubtedly familiar with *abaco* methods. In *Trattato I*, his chapter on geometry and measures is analogous to that of an *abaco* text.[30] Similarly, Francesco utilizes an *abaco* method in his lesson on quadrature and temple design in *Trattato II*. Relying heavily upon linear diagrams, his explication is given in terms of coordinate points, chords, and modules. This mathematical approach to building design and instruction complemented Francesco's desire to formulate a lucid, scientific theory of architecture. The *abaco* manual was an established, proven mode of instruction, the language and forms of which were already recognized by the practitioners whom Francesco addressed.

In contrast to Francesco's succinct, *abaco*-style explications on geometry and quadrature, other passages of *Trattato II* read more like learned commentaries on the theoretical foundations of architecture, with dozens of citations to the authoritative texts of Aristotle, Vitruvius, Plato, Cicero, Pliny the Elder, Averroes, Avicenna, Vegetius, St. Augustine, Diogenes, and Petrarch. Francesco, proficient in Latin but having no Greek, likely studied these texts through commentaries. Literary commentaries of this sort were ubiquitous in the Renaissance, and served as the principal tool in humanist study and university education (Annecchino 2005: 310–311). Commentaries and annotated manuscripts were also plentiful in the Urbino court library, which notably held a total of seventy-one copies, translations, and commentaries of Francesco's favored Aristotelian texts (Peruzzi 2004: 40). It was in this environment that the studious architect completed his translation of Vitruvius, a project he tellingly structured as a humanist commentary, glossing the Greek and Latin terms directly in the text (Martini 2002: xxiii). Thus, it was somewhat natural that when he rewrote the *Trattato*, he decided to follow more closely the commentary model. Still, *Trattato II* is not a traditional humanist commentary. Francesco did not write in Latin, nor did he limit his canon of references to literary sources. In its final form, the *Trattato* combines a breadth of mediated evidence: Italian summaries of classical philosophies, historical exempla, anecdotes from the field, and hundreds of expository illustrations.[31] While the references to ancient authorities provide an authoritative conceptual basis, for the Renaissance practitioner, the true utility of the *Trattato* lay in the advice of the seasoned architect.

Francesco served as the model for his ideal architect and did not hesitate to remind his reader of this. Addressing his students directly, Francesco routinely draws upon examples from his own practice as a means to corroborate his theoretical principles. These anecdotes not only glorify Francesco's achievements, but also underscore his conviction that the architect learns best by doing. On the 'ways to find water', for example, Francesco confidently asserts that 'many peculiarities [of this work] I have found in

many authors, and from my own great labor and diligence, and with more and more experience, I have learned them myself' (Martini 1967: 355).[32] Similarly, on the subject of ancient fireplace design (*camini*), he emphasizes that his on-site investigations were necessitated by the lack of literary evidence. 'Neither Vitruvius nor any author on architecture' discussed these difficult constructions, he notes, which are 'more difficult to comprehend from the ruins of ancient buildings' (Martini 1967: 331–333).[33] By emphasizing his own practice, Francesco indirectly defines the basic skill set he expects of his reader. The *Trattato* was for the young practitioner with a basic knowledge in design and construction processes, and thus Francesco does not hesitate to task him with the modification of a fortification plan or the development of an ornamental scheme.

In addition to long practice, the architect had to be an able draftsman. According to Francesco, only those proficient in *disegno* have the creative and conceptual facility to approach the manifold design problems posed by architecture, and to demonstrate this, he composed the *Trattato* as the consummate explication on architectural *disegno*. In layout, the tract privileges images over text. The drawings function as illustrative commentaries, framing the main body of text to elucidate the author's core principles (Cellauro 2011: 190) (**Fig. 3**). Using verbs such as demonstrate, show, signify, or manifest (*dimostrare*, *mostrare*, *dichiarare*, *manifestare*, *segnare*, *disegnare*), Francesco repeatedly instructs the reader to consult the illustrations, affirming that his concepts 'best appear in the drawing' (*come meglio appare nel disegno*). On the didactic function of the treatise, and the fundamental importance of its images, Francesco states:

> This work is ultimately not a set of instructions […] but rather it is for those who think and have some intelligence in *disegno*, without which, one could not understand compositions and parts of architecture […]; of each part I have given ample examples, and because the complete architect must invent in many unforeseen circumstances, it would be impossible to achieve that without *disegno*; and because I cannot clarify everything, these parts are left to the discretion of the architect (Martini 1967: 505–506).[34]

By granting the image such authority, Francesco also demonstrates *disegno* as an expression of *ingegno* and means of *invenzione*. On almost every subject, he provides multiple examples of each design type. The section on *case e palazzi*, for example, features sixty-eight plans for four types of houses and palaces (**Fig. 4**). This exaggerated display emphasizes the infinite number of possible design solutions, and shows how, through drawing, the architect might experiment with different forms and develop new ideas. The *Trattato* images, however, are conceptual illustrations, not definitive plans. Francesco's illustrations do not include dimensions, have few labels, and are not consistent in scale. Developed with an eye toward reproduction, the clear, unequivocal models were ideal for workshop study and reference. Francesco's oft-repro-
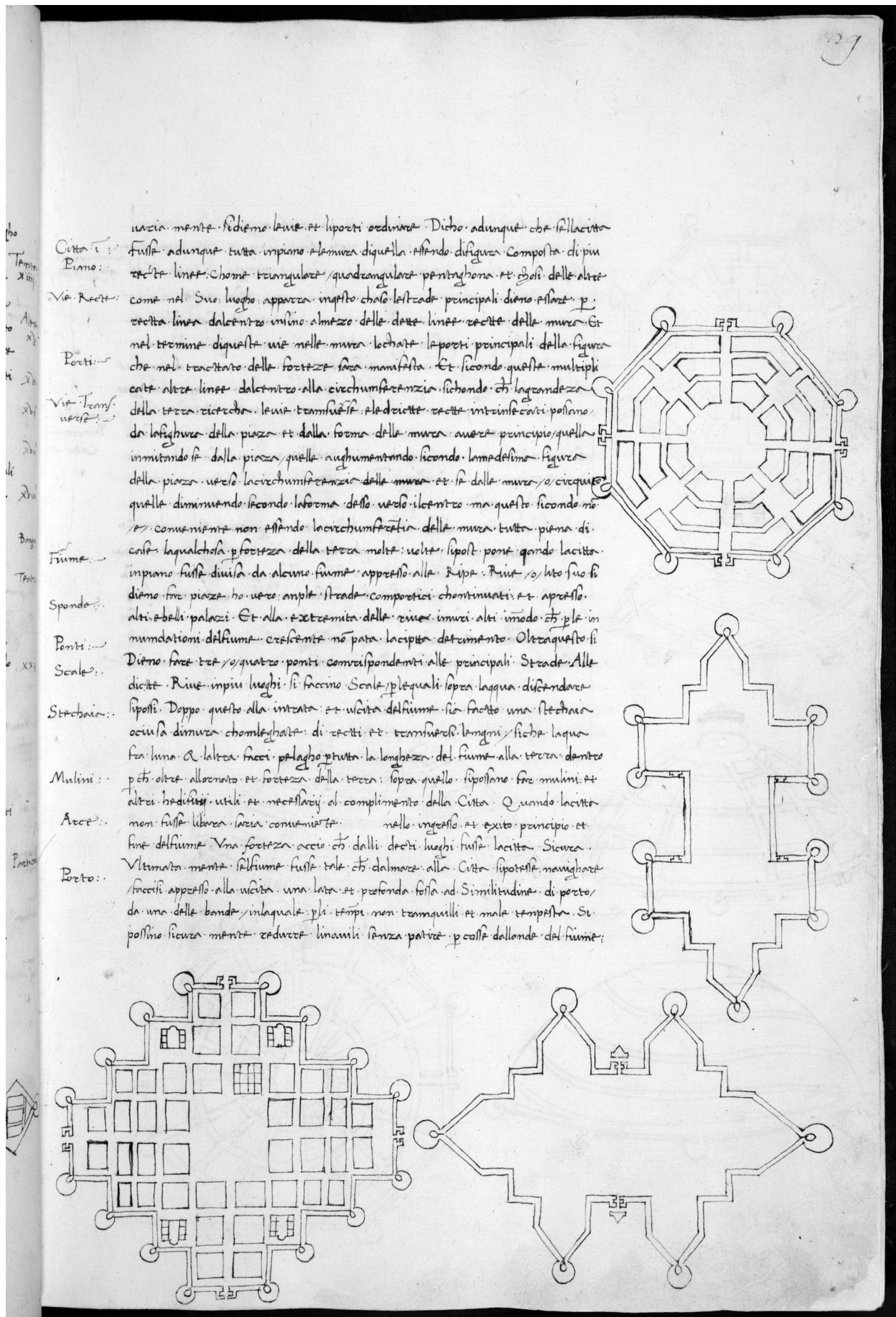
Fig. 3: Francesco di Giorgio, *Trattato di Architettura*, version II. Codex Magliabechiana II.I.141, Biblioteca Nazionale Centrale, Florence (1497–1500). Folio 29r: Plan variations for cities. Pen and ink on paper, 43.6 x 29.2 cm.
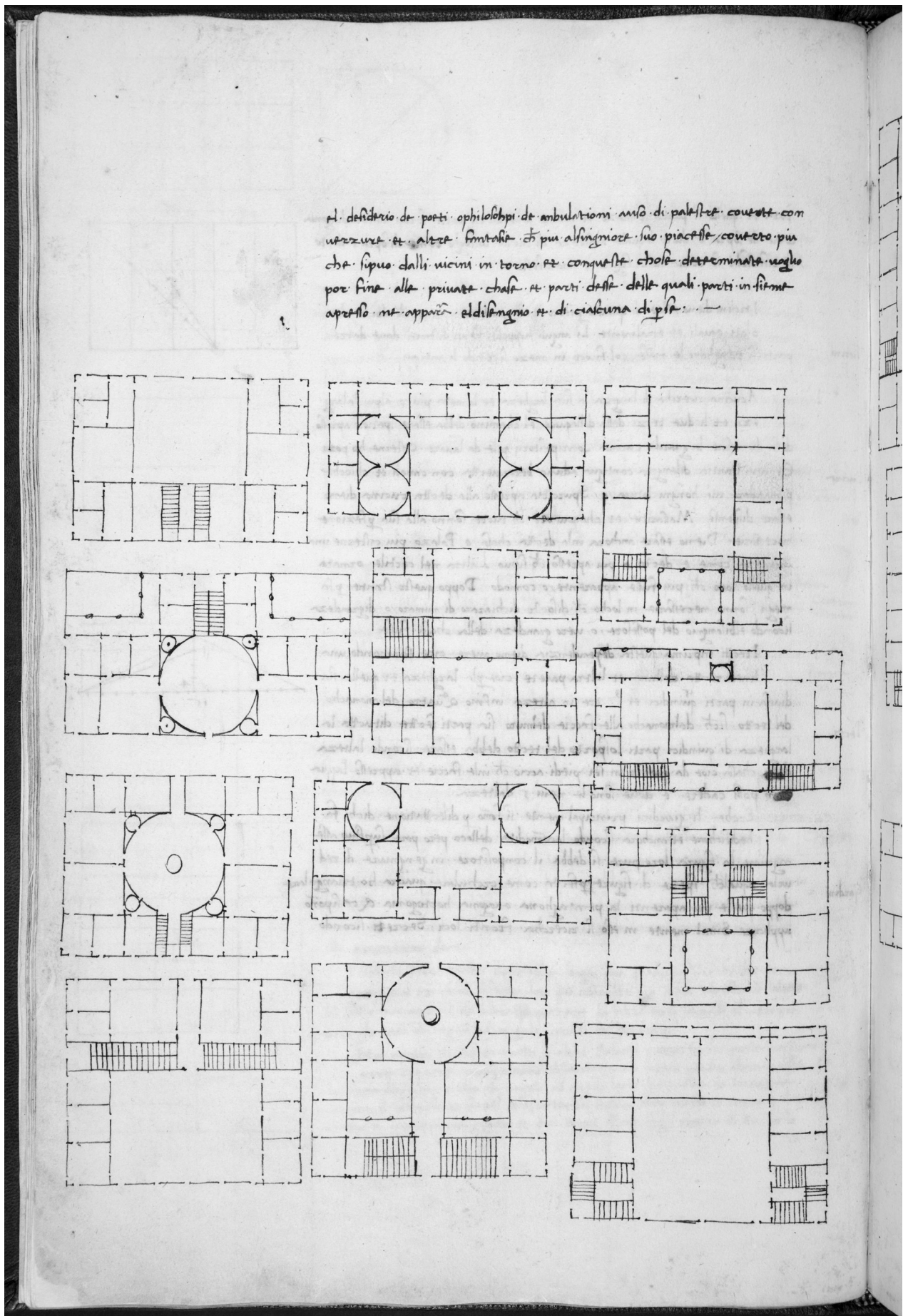
Fig. 4: Francesco di Giorgio, *Trattato di Architettura*, version II. Codex Magliabechiana II.I.141, Biblioteca Nazionale Centrale, Florence (1497–1500). Folio 18v: Plan variations for houses. Pen and ink on paper, 43.6 x 29.2 cm.

duced image of the man inscribed within a church plan, for example, illustrates the analogy between human and architectural proportions. The design does not intend to literally equate the human form with the physical building. Likewise, the perfect geometries of Francesco's fortification plans constitute ideal types that the architect would have to modify in practice.

The *Trattato di architettura*, therefore, was a didactic text, a manual for the working architect to refer to as his training progressed. Its efficacy as such may be traced in its great popularity among architects. In the sixteenth century, copies of the *Trattato* were ubiquitous. Preeminent artist-architects, including Leonardo da Vinci, Fra Giocondo, Baldassare Peruzzi, Jacopo da Vignola, Vincenzo Scamozzi, and Philibert del'Orme, carefully studied the *Trattato* and incorporated Francesco's ideas into their built and written works (Wolf 1998: 146–185). Countless other artists and architects produced compendia of its canonical illustrations, inserting Francesco-derived copy-drawings into their personal reference manuals and model-books. Yet, by this point, Francesco's designs were so well known, and so widely reproduced, that they were no longer associated with his name or the *Trattato*, and instead belonged to a universal canon of common imagery. It was as standard, generic models that Francesco's images were reproduced in the sixteenth century, refashioned in the printed engineering treatises of Jacopo di Strada, Bernardo Puccini, Vittorio Zonca, Agostino Ramelli, and others, and appropriated for new, illustrated editions of Vitruvius' *De architectura* and Alberti's *De re aedificatoria* (Reti 1963: 287–298).

The popularity of the *Trattato* images is also suggestive of the tract's widespread diffusion. Not only were there hundreds, possibly even thousands, of manuscript copies of the *Trattato*, but these were constantly circulating between artists and workshops. Quite often, it seems, apprentices were tasked with executing copies of Francesco images, either for their own reference or as part of their standard course of training (Ames-Lewis 1981: 16). The design copybook was an essential tool of the Renaissance architect and it was not uncommon for architects of the same workshop to compile nearly identical model-books. Thus, within the Sangallo family workshop, for example, the *Trattato* illustrations were reproduced by Giuliano, Antonio the Younger, Giovanfrancesco, and Giovanbattista da Sangallo.[35] Similarly, a handful of pages with *Trattato* images appears in Bartolomeo Ammannati's well-worn copybook of architectural prototypes (Uffizi A7659–A7746).

As exemplified in an extraordinary seventeenth-century manuscript on technical design, the *Trattato* drawings continued to feature in architectural education through the end of the Renaissance. The codex in question, conserved in the Staats-und-Universistat Bibliothek in Hamburg, contains numerous tracts on engineering and military architecture, including Galileo's *Delle macchine* (1592–1593) as well as thirteen folios with copy-drawings of Francesco's machine designs (**Figs 5**, **6**).[36] Although it is impossible to know if Francesco's illustrations were used in Galileo's private courses on practical mechanics, the close association between his didactic tract and the *Trattato* images in the Hamburg volume indicates that these figures were at the very least part of the same corpus of technical education. Thus, knowingly or not, a substantial school of Italian Renaissance architects was brought up using the *Trattato di Architettura*. The copies may have differed substantially in length and quality, but unmistakably, the images and ideas they featured were Francesco's.

Legacy of the *Trattato*
While a complete analysis of the *Trattato*'s impact on the evolution of Renaissance architecture is beyond the scope of this article, this final section draws attention to two well-known students of the *Trattato* and how they assimilated Francesco's theory into their own architectural treatises. Baldassare Peruzzi (1481–1536) and Pietro Cataneo (1510–1569) were both natives of Siena and succeeded Francesco as Sienese communal architects. Peruzzi likely trained under the master in the late fifteenth century, and although Cataneo never personally knew Francesco, he closely followed the celebrated Sienese architect in both his theory and practice. Like Francesco, Peruzzi and Cataneo were both generalists, experienced in military and civic architecture. Also like Francesco, both men were teachers, and sought to write didactic treatises for the emerging professional architect. But whereas Francesco confronted only one rival in his *Trattato* (Alberti), a half-century later Peruzzi and Cataneo had to contend with an ever-expanding community of architectural theorists and commentary writers. It was within this greater dialogue that Francesco's ideas on architecture were mediated. Some of these came to be incorporated as canonical principles of the discipline, while others were dismissed and gradually forgotten.

Peruzzi's treatise on architecture is among the many unfinished, and thus often forgotten, artistic tracts of the Italian Renaissance. Begun in 1527, the treatise was to serve as a course-book for Peruzzi's students in the *Studio* of Siena, where, in addition to his duties as communal architect, he was charged with teaching architecture and perspective to those who were 'interested and wanted to learn' (Annecchino 2005: 312).[37] Although the commune had long supported a 'school' of art and architecture within the Opera del Duomo, Peruzzi's contract is the first record of a formal program of architectural education (Mussolin 2009: 67). While the specific parameters of Peruzzi's course — the number of students, the format of instruction, the classroom environment, and mode of examination — are unknown, ample evidence suggests that he planned to assemble an instructional tract for his students. From the accounts of Giorgio Vasari, Egnazio Danti, Sallustio Peruzzi and Pirro Ligorio, we know that the projected treatise was to include an illustrated commentary on Vitruvius, writings on the orders and perspective, and an exposition on ancient building (Burns 1988: 207–212). In addition to Peruzzi's preparatory drawings (*c.* 1527–1531), held today in the Uffizi and the Siena Biblioteca Comunale, a preliminary copy of the incomplete manual also exists, in the Österreichische Nationalbibliothek (Vienna) (Annecchino 2005: 313; Toca 1971).[38]
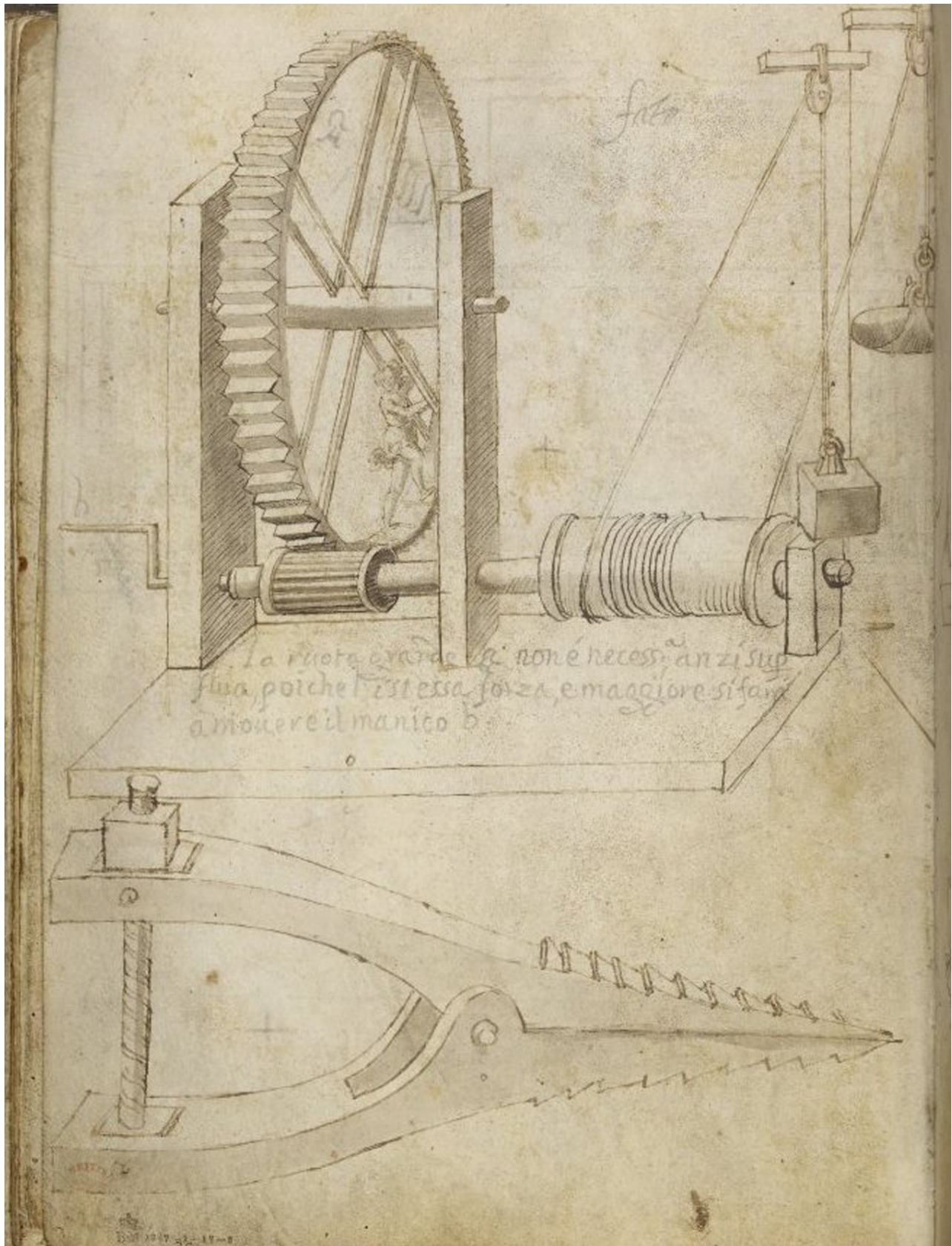
Fig. 5: Francesco di Giorgio, *Opusculum de architectura*. Ms. Lat. 197b 21, British Museum, London (c. 1475). Folio 24v: Windlass worked by treadmill; shears. Pen, brown ink and brown wash on velum, 27.4 x 22.9 cm. © The Trustees of the British Museum.

The Vienna codex opens with a statement of purpose in which Peruzzi relates that upon the request of friends, he has decided to write a tract on architecture. The trea-

tise, he vows, will be different from previous ones, which, 'filled with many long problems, and written in such prolix language seem, more like the work of a historian or
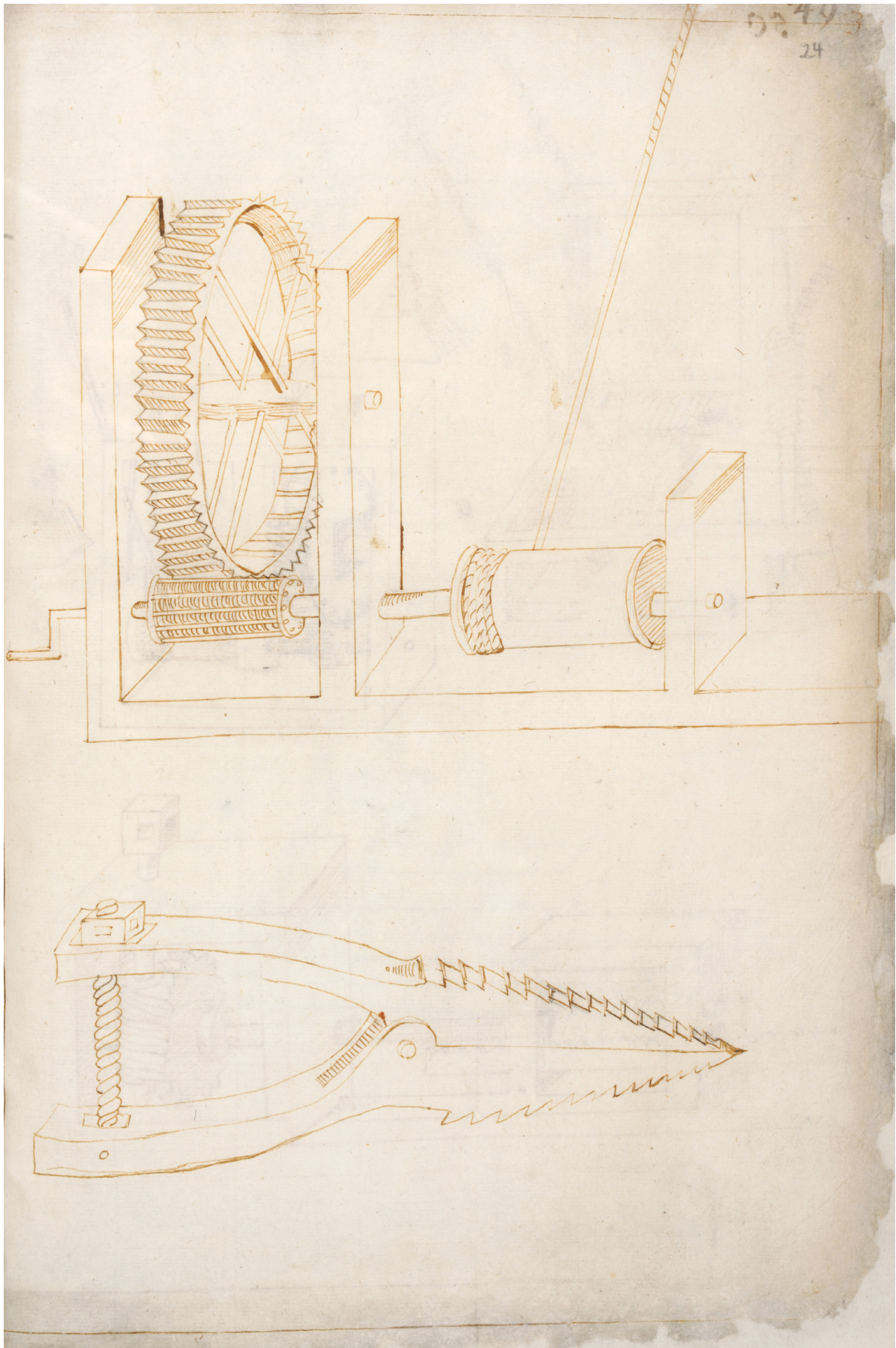
Fig. 6: Anonymous, copy-drawings from Francesco di Giorgio's *Opusculum de architectura*. Codex Math 200, Staats- und Universitätsbibliothek, Hamburg (c. 1590–1600). Folio 27r: Windlass worked by treadmill and shears. Pen and ink on paper.

chronicler than a master.' Rather, as communal instructor, Peruzzi promises 'to speak tersely, discussing [the material] generally and positively in such a manner that I hope that it will be useful and understandable to all its readers.'[39] Following these introductory statements, he includes a four-page summary outlining the contents of his proposed thirty-two-book treatise. But it is here that the discerning reader begins to recognize that, contrary to Peruzzi's claims of originality, his treatise is not actually so different from previous ones, as in fact much of his treatise derives directly from Francesco's *Trattato*.[40]

Peruzzi's thirty-two-book tract, it appears, was intended to revise and expand upon Francesco's original seven books. As in the *Trattato*, Peruzzi opens with an exposition on materials and site conditions, and leaves ample space for the discussion of 'utilitarian' constructions — fortifications, mills, artillery, chimneys, and bathrooms. But Peruzzi's manual differs from the *Trattato* in its organization. The concise books, each no longer than a page or two in length, focus on basic information and examples, providing material in a manner that is accessible and easy to reference. For example, whereas the *Trattato* covers quadrature, temple design, and the columnar orders in one book, Peruzzi's divides this material into seven sections, dedicating three chapters to the orders, and four chapters to temples, their forms, proportions, and ornaments. Still, the fact that Peruzzi used the *Trattato* as the basis for his architectural textbook speaks to the authoritative status of Francesco's treatise. For Peruzzi and his sixteenth-century contemporaries, Francesco's *Trattato* was the definitive manual on practical architecture, and just like any popular text, it had a decisive impact on how its users thought about their work. In his role as Communal instructor, Peruzzi set out to teach a modified version of Francesco's 'first principles', focusing on *disegno*, technical acumen, and on-site experience. In this, he prepared an entirely new generation with the ideal of the practically minded architect-technician.

Pietro Cataneo was likely among the students who attended Peruzzi's course at the *Studio* of Siena, and was possibly also active within the Peruzzi workshop (Cataneo 1985: 165). The son of a stationer and book dealer, Cataneo was first introduced to architecture through his work within the *Studio* scriptorium, where he copied treatises, commentaries, and course manuals, including the different versions of Francesco's *Trattato di architettura*. After completing a course in advanced mathematics, he published a treatise on *Le pratiche delle due prime matematiche* (1546) (Binaghi 2000: 44). An elaboration on the standard *abaco* manual, *Le pratiche* is a mathematical treatise written for architects, filled with concrete examples and calculations related to construction costs, material quantities, and the measurement of areas and volumes (Binaghi 2000: 44–46).[41]

Cataneo's conception of architecture as a practical, mathematical discipline also stands at the heart of his second treatise, *L'architettura di Pietro Cataneo Senese* (1567).[42] Focused more specifically on architecture, the seven-book tract provides a pragmatic schema for the profession. Although Cataneo never cites Francesco, the authoritative precedent of the *Trattato* is readily apparent throughout. Not only does the *L'architettura* follow the *Trattato* in format, integrating text and illustrations and even reusing some of the same figures, but its essential theory is also analogous to that provided by Francesco. Cataneo opens his treatise with a strikingly familiar proclamation, in which he defines architecture as a science and characterizes the architect as a man of natural *ingegno*, skilled in drawing, geometry, perspective, and arithmetic and learned in history and medicine (Cataneo 1985: 185).[43] The ensuing books expound on the same core concepts highlighted in the *Trattato*, albeit in a more systematic and condensed manner. For example, in Book One, on site conditions and city planning, Cataneo specifies that the expert architect must have 'good experience' in all aspects of the building environment, and following the *Trattato* model, he provides concrete examples, many of which concern Siena or Tuscany (Cataneo 1985: 267).[44] Cataneo's geometrical approach to building design (Book Three) is also comparable to Francesco's. Just as in the *Trattato*, Cataneo utilizes abstract, geometrical plans, which he refers to directly in the text — '*come per la presenta pianta si dimostr'* — and echoing Francesco, reminds the reader that his plans are only prototypes, a mere sampling of the infinite number of possible inventions the architect might devise (Cataneo: 1985: 343).[45]

Of particular significance are Cataneo's references to the 'Architect', a title he capitalized, and the architectural profession — '*professione di buono Architetto*' (Cataneo 1985: 185). As a state-employed architect in mid-sixteenth-century Italy, Cataneo witnessed first-hand the continual technological advancements that demanded designers with ever more mechanical know-how. States and republics required practically minded professionals, technicians proficient in hydrologic and civil engineering, metallurgy, and machine design; more than ever, the Albertian architect — the knowledgeable humanist with general skills in draftsmanship but little on-site experience — was an unacceptable and dangerous model (Valleriani 2010: 196–197).[46] Cataneo's treatise, dedicated to the popular Sienese ruler Aeneas Piccolomini, was thus both a natural extension of Francesco's *Trattato* and a revisionist proposal for sixteenth-century architecture. Pushing back against increasingly prevalent humanist-architect, Cataneo extolled the Vitruvian model of the polymath architect-technician. This conception of architecture was consistent with the deeply engrained Sienese tradition, exemplified in the tracts of Taccola, Francesco di Giorgio, and Peruzzi.

But Cataneo was among the last to promote the training of a generalist-architect. By the close of the sixteenth century, architecture had split into two distinct specializations — civil and military — and Francesco's conception of the architect-technician, dexterous in both fields of practice, was all but obsolete. While the *Trattato* was still consulted by the period's leading military engineers — individuals like Galeazzo Alessi, Giovan Battista Belluzzi and Buonaiuto Lorini — by the mid-1500s civilian

architects had at their disposal an entirely new canon of practical treatises.[47] In this century, more architectural treatises, manuals, commentaries, and pattern books were published than ever before. In addition to the tracts of Vitruvius and Alberti, which were reprinted in multiple editions, Sebastiano Serlio, Jacopo Vignola, Philibert del'Orme, and Andrea Palladio also published new treatises on architecture. Yet there was still no consensus on the architect's role or even on the definition of architecture. Just like Francesco, Serlio, Vignola, Philibert, and Palladio composed treatises in an effort to structure the discipline. Their varying proposals for the professional architect — the building designer (Serlio), the gentleman-specialist (Philibert), and the humanist-antiquarian (Palladio) — demonstrate the lingering dissatisfaction with the way architecture was practiced, codified, and taught. Francesco's *Trattato* was among the most resonant theories in this period of continual inquiry and progression, and aspects of his theory, such as the primacy of *disegno* and the necessity of architectural invention, came to be widely accepted as intrinsic to the discipline. But Francesco did not define the professional architect —arguably, no one ever would. Rather, his *Trattato* provided a highly influential paradigm for the profession in a pivotal period of architectural history, offering models and methods for innovative design.

Notes

This paper was researched and written during a predoctoral exchange fellowship at Humboldt Universität in Berlin (2012–2013). I am grateful to those who have discussed Francesco di Giorgio's *Trattato di architettura* with me, in particular Paul Barolsky, Cammy Brothers, David Summers, and Matteo Valleriani.

[1] *Codicetto Vaticano* Ms. Lat. Urbinate 1757.

[2] 'Ma io, non avendo di questo molestia, solo questo merito delle fatighe mie aspetto, che da qualche intelligente da alcuna parte mi serà rendute grazie se non come determinatore, almeno come motore delli altri ingegni più sublimi e virtuosi.'

[3] In sequential order, the four versions of the *Trattato* include (1) the "proto-*Trattato*" or antecedent to *Trattato I,* c. 1476 (conserved in the Zichy-codex, Erwin Szabo Public Library, Budapest); (2) *Trattato I*, c. 1478–1481 (codex Ashburnham 361, Biblioteca Medicea-Laurenziana and codex Saluzziano 148, Biblioteca Reale, Turin); (3) the *Opera di architectura*, c. 1487–1488 (codex Spencer 129, New York Public Library); and (4) *Trattato II*, c. 1487–1500 (codex S.IV.4, Biblioteca Comunale, Siena and the codex Magliabechiana II.I.141, Biblioteca Nazionale Centrale, Florence). One might also recognize at least two distinct stages of development for both *Trattato I* and *Trattato II*, as reflected in the principal surviving copies. The dating of the *Trattato* has received critical attention from Betts (1977), Maltese (Martini 1967), Mussini (1993 and 2003), and Scaglia (1991). The chronology given here is that provided by Mussini (1993, 2003). My reading of the *Trattato* uses the transcriptions provided by Corrado Maltese in his two-volume critical edition (Martini 1967). The translations are my own.

[4] For example, in book three, on 'Cities', Francesco begins well over half of the sentences with either '*Anco*' or '*E.*' Of the total seventy-three sentences, forty-six begin with 'and' or 'also.' See Martini 1967: 20–25.

[5] Here I am referring to folio 20v of the codex Saluzziano. See Martini 1967: table 36.

[6] For discussion of Francesco's possible activity in Naples in the mid-1480s see Martorano 2004: 173–185. On Francesco's studies of antiquities, known through the so-called *Taccuino dei viaggi* (Uffizi A318–337) see Burns 1994: 330–357.

[7] Although Maltese (Martini 1967) and Scaglia (1985) have suggested that Francesco relied upon Sulpicio Verolano's 1486 Latin edition of *De architectura* in completing his translation, Mussini (2003) confirms that there is no concrete evidence for this claim.

[8] It is possible that Piero della Francesca assisted Francesco with his translation of Vitruvius. In the 1480s, Piero was also in Urbino, and between 1482 and 1492 he composed his *Libellus de quinque corporibus regularibus*, the dedication to which demonstrates his familiarity with *De architectura*. On the Vitruvian dedication to *Libellus*, see Davis 1977: 44–45.

[9] At least twenty-nine surviving copies of the *Trattato* have been linked to the Magliabechiana prototype. See Scaglia 1992: 25, 34–37.

[10] Scaglia (1992) has argued that copies of the *Trattato* were executed in the scriptorium of Monte Oliveto Maggiore, but as Mussini (2003) emphasizes, there is no definitive proof of this. The copies might have been executed in smaller scriptoria, or by individuals within Francesco's workshop. On the copy and distribution of manuscripts in the Italian Renaissance, see Richardson 2009.

[11] Fra Giocondo was one of the many artists paid to execute copy drawings of Francesco's original designs. For the document, see Weller 1943: 382.

[12] In addition, the Uffizi, Gabinetto dei Disegni e delle Stampe, holds several loose pages of Francesco di Giorgio stock illustrations prepared by an anonymous sixteenth-century copyist (U520A–U522A). The figures on these sheets are numbered, presumably according to the position they would take within the assembled *Trattato* copies.

[13] For a synopsis of Francesco's use of Aristotle in the *Trattato*, see Lowic 1982: 153–160.

[14] For a history on the negative associations of the mechanical arts, see Biagi 1965.

[15] 'Parmi assai sufficientemente sia ditto delli cinti delle mura, peroché el prudente e perito architetto, di più parti che per le regule et esempli ha conusciuto et inteso, porrà quelle adattare et applicate che si converrà alla natura del sito, aggiugnendo e diminuendo e componendo.'

[16] '[…] et a questi si può fare infinite e varie invenzioni sicondo la intelligenzia di quelli che in tali esercizi sono esercitati.'

[17] 'Tre sono le principali spezie di templi, quanto alla sua forma e figura, alle quali infinite particulari figure si possono redurre, secondo infinite invenzioni che nella mente dell'architetto possono occorrere. [...] Dico adonque che la architettura essendosi trovata successivamente, siccome tutte le altre scienzie, l'uno agiognendo all'altro.'

[18] In *De ingeneis*, Taccola explicitly assigns the design of mills, bridges, and other 'utilitarian' mechanisms to the architect, whose ability to realize these structures distinguished him from the common craftsman. For transcriptions and translations of *De Ingeneis*, see Prager and Scaglia 1972.

[19] '...senza quello [disegno] non si può bene intendere le composizioni delle parti dell'architettura, et oltre a questo perché questa arte, oltre a la scienzia et intelligenzia acquisita da libri e disegni, ha di bisogno di invenzione, senza la quale non è possibile essere bono architetto, perché molte cose, non potendosi descrivere né insegnare, bisogna restino nella discrezione e giudizio dell'artefice. [...] Ultimamente, perché come ho ditto la invenzione è necessaria a perfezione dell'arte, molti, avendo in la mento fabbricato uno edificio con le sue convenienti proporzioni, non possono poi mettarlo in opera, non sapendolo né a sé né ad altri col disegno dimostrare.'

[20] 'Perché ogni nostra [cognizione e] notizia dello intelletto ha origine dal senso, come testifica Aristotele nel primo della Posteriora, e nel secondo e terzo dell'Anima, et in fra [tutti] li altri sensi [esteriori] el vedere è più spirituale, puro e perfetto, e più cose e differenzie ci demostra, non pare che lo intelletto nostro così possi [perfettamente] comprendere alcuna cosa né longo tempo tenere, se quella col senso del vedere non ha conosciuto, o almeno cosa simile a quella, per cui cognizione l'intelletto si eleva a conoscere la prima.'

[21] Francesco's relationship with Alberti is often considered by scholars. Fiore and Tafuri (1994) highlight the differences between the two, characterizing Francesco di Giorgio as '*albertianamente antialbertiano*'. Canali (2002) has speculated upon Francesco's possible contact with Alberti as a young man in Siena. Mussini (2003) makes numerous comparisons between Alberti's theory and that of Francesco di Giorgio.

[22] The extent of Antonio di Tuccio Manetti's architectural career is uncertain, although he was widely recognized as an expert in mathematics, geometry, and astronomy. In a document of 1491, he is named 'civis et architectus' in regards to his role on the advisory committee of Santa Maria del Fiore. See Manetti 1970: 17–18.

[23] '[Onde] per questo non senza ragione nelle menti delli vertuosi nasce meraviglia: qual sia la cagione che tanto tempo sia stata ascosa e totalmente persa; e parimente ignote le forze delli vocabuli usati per li autori che della pittura et architettura, parte dell'antigrafica, hanno a noi lassati i libri, massime essendo in questo tempo stati più omini da la natura dotati di suttilissimi ingegni.'

[24] '[...] benché a me non sia ignoto alcuni moderni in questa arte avere commentato e scritto, peroché infine nelli utili e difficili passi legermente quelli trovo esser passati. Onde, avvenga che a molti paia da qualche breve tempo in qua si sia ritrovata la architettura, intesi li fondamenti, regule e conclusione d'essa, senza arroganzia e suspizione di debita reprensione si può dire che tutti li edifici moderni sieno pieni di errori e di parti senza la debita proporzione o simmetria.'

[25] '[L'architetto], la quale senza antigrafice è nulla e molte volte manca in quello ancora dove si estende.'

[26] Alberti comments: 'Let it be enough that he has a grasp of those elements of painting of which we have written; that he had sufficient knowledge of mathematics for the practical and considered application of angles, numbers, and lines, such as that discussed under the topic of weights and the measurements of surfaces and bodies [...] If he combines enthusiasm and diligence with a knowledge of these arts, the architect will achieve favor, wealth, fame for posterity, and glory.'

[27] On the 'Ornament of Private Buildings' Alberti is explicit: '[T]o make something that appears convenient for use, and without doubt be afforded and built as projected, is the job not of the architect so much as the workman. But to preconceive and to determine in the mind and with judgment something that will be perfect and complete in its every part is the achievement of such a mind as we seek [as architects]' (Book IX.10, Alberti 1988: 315).

[28] 'Consequentemente è da sapere che li ornamenti non necessari possono essere di più spezie, come [di] colonne morte e vive overo integre, di cornice, ricinti, stucchi, figure, riquadrati in palchi et altri modi li quali [io] per lo disegno dichiararò al quale mi referisco per resecare ogni superfluo parlare.' Francesco's conception of ornament bears a debt to Vitruvius. As given in the *Trattato*, ornament is an artistic display and a product of the architect's creativity and invention. Alberti also understood ornament as artistic display, and like Francesco defined ornament as an auxiliary component of building. However, Alberti placed much greater value on ornament than Francesco. In *De re aedificatoria*, he pairs beauty with ornament and teaches that the architect's greatest concern is to make a beautiful building. See Payne 1999: 93–97; Alberti 1988: 154–157.

[29] 'Ma sono molti speculativi ingegni che per loro solerzia hanno molte cose invente e dell'altre antiche come di nuovo ritrovate quelle descrivendo, e per non avere el disegno sono difficilissime ad intendare, perché siccome noi vediamo sono molti che hanno la dottrina e non hanno l'ingegno, e molti dotati d'ingegno e non di dottrina, e molti hanno la dottrina e lo ingegno e non hanno el disegno.'

[30] Maltese reproduces the folios of the codex Saluzziano 148 in his critical edition. For the chapter on geometry and measures see Martini 1967: tav. 50–61. Presumably because of their utility, few *abaco* books remain extant. The Biblioteca Marciana, Venice holds a well-preserved, fifteenth-century *abaco* text (codex Italiani IV, 35, 5570).

[31] In the prologue, Francesco states that his purpose in writing the *Trattato* was to explain good architecture in a clear and comprehensible manner, and that he resolved to avoid no fatigue to achieve this end: 'E desiderando in l'arte del disegno e dell'architettura, parte dell'antigraficie, venire a qualche cognizione, feci fermo proposito di non perdonare a fatiga alcuna la quale io vedevo necessaria per pervenire a questo fine.' In Book V, Francesco notes that examples are superior for learning, because they are easier judged and remembered by those who are not very expert or learned: 'però che li esempli più movino l'intelletto che le parole generali, massime quelli che non sono molto esperti et eruditi.' Martini 1967: 295; 445.

[32] This is a liberal translation of a somewhat awkward sentence: 'quali modi curiosamente ho tratti di più autori, e con fatiga e di‹li›genzia facendo più e più esperienzie ho trovato da me.'

[33] 'Non è parte alcuna delle case che per le ruine e reliquie delli edifizi antiqui meno si possi comprendare e la forma sua descrivare che li camini […] e non ho mai trovato omo che di notare simili antiquità si sia dilettato che ne abbi avuto notizia di alcuno; e meravigliomi che né Vetruvio né altro autore di architettura in le loro opare non abbi mai fatto alcuna menzione di camini.'

[34] 'Uno documento ultimamente non è da pretermettare al quale dieno avere avvertenzia quelli che di questa mia operetta desiderano consequire alcuno frutto, e questo è che questi tali s'ingeg‹n›ino avere qualche intelligenzia del disegno, perché senza quello non si può bene intendare le composizioni e parti dell'architettura perché le superficie esteriori comprano le interiori e d'ogni parte longo saria dare esempli, e perché il completo architetto richiede la invenzione per molti casi occurrenti indescritti che senza disegno è impossibile consequire, e perché non possendo ogni minima parte dichiarare, quelle che restano ‹sono› nella discrezione dell'architetto.'

[35] Giuliano included copy-drawings after Francesco in his Taccuino (Codex S.IV.8, Biblioteca Comunale, Siena) and his codex Barberini (Vat. Lat. 4424). Antonio da Sangallo the Younger meticulously reproduced the images on folios (now conserved in the Uffizi) which appear to have been prepared for binding. The Uffizi also holds *Trattato* copy-drawings by Giovanfrancesco and Giovanbattista. See Scaglia 1992.

[36] Codex. Math. 200. On the Hamburg version of Galileo's *De Macchine* and the Francesco di Giorgio copy-drawings, see Valleriani 2010: 71–112.

[37] Peruzzi's contract stipulated that he 'sit obligatus eius artem [si tratta dell'architettura] docere omnes querentes et volentes discere.'

[38] The so-called *Taccuino Senese*, (codex S.IV.7, Biblioteca Comunale Siena) is attributed to Baldassare Peruzzi and his circle. The Österreichische Nationalbibliothek, Vienna, holds two codices related to Peruzzi's treatise project: one dedicated primarily to text (codex 10873) and one with illustrations (codex 10935).

[39] The introduction is given on folio 2r and reads: 'Molse adlo anxilio dellattissimo Iddio, senza el quale alcuna cosa ne celeste ne terena si move, presi animo adescrivere e figurare [?] opera pertinente ad architecture per lassare ali posteri le fatigue estudi che in decta arte oesperimentato e etia per honesti stima per suasione factami da moltissimi amici amatori dele virtù. E de diserosi di vedere a luce cosa che sia acomune utilita di ciascuno virtuoso edifiblime ingegno possi per persumptione per avere visto piu opere scripte, di desta arte da alcuni maderm. architetti e chi in un modo chi in uno altro la descrive chi avoluto tradurre evulgarizare le scellentissimo testo di Vitruvio, chi se a usurpate le sue fatighe del atri vi usando el premio de in gratitudine procedendo in tanti longsi problemati e tanta perlixita che in piu sip o dice isto via a che magisterio fastidisce el lettore e lo auditore facendo piu narrationi di cose aliene che di quelle et allarte se aperengono; ne io prometto in questa opera exquisite ne terso parlare discrivendo trivalmente e positivamente in tal modo ch' io spero che saria questa opera utile e da tutti li lettore intesa.'

[40] On several folios, such as 42r, the copyist even included the source of the material. This folio bears the title, '*Incipit poemiu Francisi Georgii Senesis architecttis liber primo Capitolo I.*'

[41] In content and sophistication, *Le pratiche delle due prime matematiche* (1546, reprinted in 1559) was comparable in to a mathematical treatise of a university professor.

[42] In 1554 Cataneo published a partial version of this treatise with the title *I Quattro primi libri di archittura.*

[43] 'As architecture is a science of many doctrines and various complicated teachings, & [which requires] the judgment of those approving all the works that this art is complete; it will also be necessary for he who wishes to make the profession of the good architect, to be scientific, and of with natural *ingegno*, as he who is clever without science, or scientific without *ingegno*, cannot be the perfect architect. Before one can be well instructed in this art, or science, it is necessary that he be a good drawer, excellent in geometry, most able in perspective, optimal in arithmetic, learned in history, and have an understanding of medicine, as such sciences are necessary.' ('Per essere l'Architettura scienza di più dottrine e vari ammaestramenti ornata, col giudizio de la quale approvandosi tutte l'opere, che dall'altre arti si finiscono, serà di bisogno ancora a chi vorrà far professione di buono Architetto essere scientifico, e di naturale ingegno dotato. Però che essendo ingegnoso senza scienza, overo scientifico senza ingegno, non potrà farsi perfetto Architettore. Dove gli sera necessario, prima che si possa render bene istrutto di questa arte o scienza, esser bono disegnatore, eccellente geometra et aritmetico, bonissimo prospettivo, dotto istoriografo, et abbia tal cognizione di medicina, quale a tale scienza si conviene.')

[44] 'Quando adunque si fabricherà in luoghi che dei loro domini si sieno per più anni messe in opera le loro pietre, si conoscerà facilmente per la loro stessa sperienza la natura di quelle. Ma se di nuovo si fabricherà città,

castello, o villa dove non fusse vestigio di abitazione o muraglia alcuna, serà allora necessario, per fare di buona sperienza, cavare la state di tale paese di ogni sorte petrina.'

[45] On variation and invention in regards to palace plans, Cataneo writes: 'Bella cosa è veramente il variare dagli edifizi ordinari: di che molte volte con lode universale se ne acquista la grazia della republica, o del suo signore. Sforzerommi pertanto di più inventioni, che mi vengono in mente, darne alcune esempio, che più mi paia da dover essere messo in opera, quantunque i medesimi si potessero diversamente mostrare.'

[46] Cataneo references Alberti twice in his treatise – in regards to larch wood and the Doric capital. On the latter topic, he is particularly dismissive of the Florentine architect, commenting that his proposal for the Doric capital '*per mio avviso è molto mal proporzionato, e però mostruoso*'. See Cataneo 1985: 274, 355.

[47] On Belluzzi's familiarity with Francesco's *Trattato di Architettura* and his built works, see Lamberini 2007: 292. For Galeazzo Alessi's debt to Francesco, see Coppa 1999: 31–32. Lorini's treatise *Delle Fortificationi* also bears many parallels to the *Trattato* and certain passages, including that on *disegno*, derive directly from the earlier text. See Lorini 1597.

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