Architectural Criticism, Science, and Visual Eloquence

Teofilo Gallaccini in Seventeenth-Century Siena

ALINA A. PAYNE, *University of Toronto, Toronto*

Historiography

In 1786 Andrea Memmo starts off his *Elementi d'architettura Lodoliana* with the statement that Baroque architecture "non architettura, ma chinese, o grottesco potrebessi nominare" (should not be termed architecture, but Chinese or grotesque).[1] This radical view belonged to Father Carlo Lodoli (1690–1761), a Franciscan polymath who had played a significant role in the cultural life of Verona and Venice where he lectured on astronomy, mathematics, physics, and theology and where he entranced salon after salon with his eccentric views. Most importantly, he had been entrusted with the private education of the scions of the Venetan nobility; the unorthodox curriculum he developed was much talked about, especially as it concerned architecture. Lodoli's eloquent criticism of the ignorance of engineering that had led to the structural failure of so many buildings, and his near-fanatical emphasis on knowledge of materials as prerequisite to good architecture, had made him notorious. It is this component of his thought that Andrea Memmo, Venetian ambassador to the Vatican and his former pupil, records several decades after Lodoli's death.[2]

The statement Memmo used to introduce Lodoli's theory carries all the flavor of Michel Foucault's reaction to Jorge Luis Borges's Chinese encyclopedia and its alien taxonomy. Indeed, it functions in much the same way; the posture of noncomprehension and unfamiliarity describes a clearly perceived watershed.[3] The implication was unmistakable: on the one side lay the misshapen architecture of the past; on the other, the promise of a new beginning based on Lodoli's precepts. Modern scholarship has tended to validate Lodoli's claim. Like Marc-Antoine Laugier, the author of the seminal *Essai sur l'architecture* (1753), Lodoli is to be found in the opening paragraphs of every survey of modern architecture.[4] Rejecting ornament for ornament's sake and focusing on the engineering of buildings, both theorists signaled a turning point in the definition of architecture. The structural rationalism of the one and the functionalism of the other paved the triumphant path of modernism that led from Jean-Jacques Soufflot to Ludwig Mies van der Rohe.[5]

Lodoli's biting criticism of the ancient Romans, of Palladio and Scamozzi, Michelangelo, Gianlorenzo Bernini, Carlo Borromini, Pietro da Cortona, Martino Longhi, Carlo Maderno, "and so many famous *[reputatissimi]* modern Romans" bears out the watershed status he claims for himself.[6] Earlier he had also named the Rossis and the brothers Pozzo and used Count Alessandro Pompei's 1735 treatise on the orders as conclusive evidence to support his sweeping criticism.[7] Indeed, Pompei had railed with comparable vehemence against the architectural abuses of his time. Like Memmo, he attacked the "broken and double curved frontispieces," the volutes as supporting members in lieu of columns, the virtual absence of straight lines, in short, the overwhelming presence of forms "curved into one hundred directions, contorted into one hundred rotations, to which Virgil's description of the snake would apply: it folds and twists and curls back upon itself."[8] Moreover, Pompei added wistfully, "none of the present work displays carvings, fluting and low relief that delight the eye in the Italian buildings of the *buoni tempi*"—that is, the times of Jacopo Barozzi da Vignola, Andrea Palladio, Vincenzo Scamozzi, and Michele Sanmicheli, on whom his treatise focuses. For this reason, he suggested, "we are justified in turning back. It is a most worthy thing to be back with the modern Italian buildings of the *buoni tempi* just as much as with the ancient ones."[9] Like the poetry of Giovanni Battista Marino and the Marinisti, Baroque architecture, he claimed, is symptomatic of a general downward trend in taste that affected all aspects of culture. And, consistent with the tenets of the Accademia dell'Arcadia (of which he was a member), the only salvation Pompei envisaged was a return to the sound principles of the Renaissance.[10]

This attitude is not novel in the criticism of the arts and literature of the time and had been well established since the publication of Giovanni Pietro Bellori's *Vite* in 1672. Bellori had not paid much attention to architecture, it is true, yet he had criticized those who "worry the angles, break and distort lines, misassemble bases, capitals, and columns with bits and pieces, stuccoes, and poor proportions," citing the Greeks, Vitruvius, and sixteenth-century architects.[11] But within this larger cultural rejection of the literary and visual arts of the

seventeenth century, Pompei's criticism had a more specifically architectonic thrust: the origin of all the defects he lists is the false representation of the working structure through ornament. In his view, curving volutes do not signify stable support for weights and therefore cannot logically take the place of columns; broken pediments suggest broken trusses and so contradict the implications of imaginary roofs; twisting and bulging forms appear soft and weak and do not adequately display the bearing function of walls; flowers and fruit cannot support heavy cornices, and so on.

If visual fussiness is one of Pompei's targets, his principal concern is for the logical imitation of weight bearing. "Nature must be imitated by art, and embellished, but never deformed," he proclaims.[12] Such statements and the terms he uses—"represent," "display," "demonstrate"—occur frequently in the theoretical literature he draws on, the great treatises of the Renaissance that give voice to an aesthetic of imitation for architecture. And to this aesthetic Pompei wholeheartedly subscribes.[13]

Lodoli's criticism is similar if more stringent, for not even the *buoni tempi* of the Renaissance meet the exacting standards of his sparsely populated Pantheon, nor yet the Romans or even the Greeks.[14] He also states clearly the reasons why the abuses he deplores are reprehensible: "Palladio and Scamozzi did not understand the mechanics and statics of buildings, the foundation of good architecture," he complains.[15] Michelangelo is his bête noire: he indulged in *licenzie,* and "he stumbled into so many errors and *capricci* because he did not uncover the origin and essence of architecture." Such an approach inevitably led to the *libertinaggio* of Borromini and the modern school.[16] Anticipating counterarguments regarding the magnificence of these structures and their status in the cities where they are to be found, Lodoli adds preemptively that he does not seek magnificence ("a pleasant illusion") but buildings that are "raised on clear principles, so to speak, of eternal truths, that could not suffer opposition at any time."[17]

"Clear principles" and "eternal truths" are the recognized ways of the sciences; and, indeed, in the remainder of the text, so Memmo tells us, Lodoli seeks to locate architecture among them. For him "architecture . . . should be a science, not a simple and physical *[semplice e materiale]* art. All sciences include precise knowledge of things based on perceivable principles and on demonstration."[18] Accordingly, Palladio is dismissed for saying that architecture imitates nature; so is Scamozzi. Although the latter maintained that architecture is a "sublime speculative science" *(sublime nella speculativa),* he eventually "reduced it" (Memmo's term) to a mimetic art.[19] Such a move was tantamount to inscribing architecture into the figural arts, and this Lodoli cannot tolerate.

Pompei and Lodoli are two mountain peaks, but they belong to a range; indeed, they speak for a larger intellectual community in ferment. Tommaso Temanza, in his life of

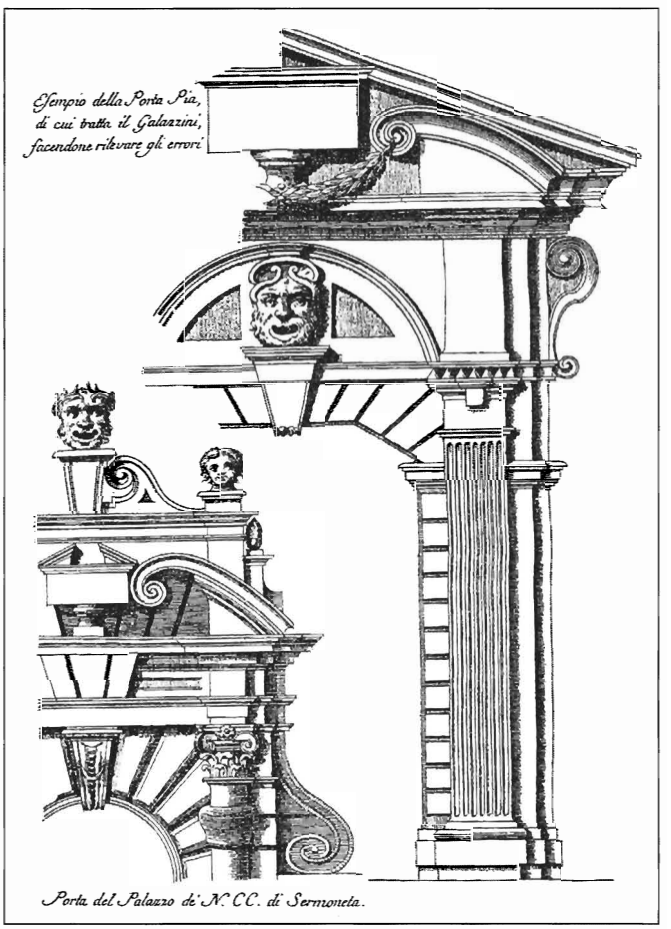

FIGURE 1: Teofilo Gallaccini, *Trattato sopra gli errori degli architetti* (1767)

Palladio of 1762, for example, had compared him with Raphael and advocated a return to the great architecture of the sixteenth century as a countermeasure to contemporary excesses.[20] Temanza's whole oeuvre points in the same direction, for (like his friend and colleague in arms, Francesco Milizia) he also published the biographies of Sansovino and Scamozzi as well as a comprehensive work on sixteenth-century Venetian architects.[21] This move, to reorient contemporary practice, noticeable among Palladian grand tourists and Venetian patriots, historians, and critics, also included architects, most notably Francesco Muttoni, Antonio Visentini, and Francesco Maria Preti.[22]

This group, to which Pompei belonged, at least looked favorably on ancient and Renaissance architecture. Lodoli's radical rejection of the past, however, left him with few authorities beyond Vitruvius.[23] Not even his contemporaries Milizia and Temanza were sufficiently rigorous in his eyes, though on occasion Milizia earned his approval.[24] To be sure, scientist-scholars like Count Giovanni Poleni, who occupied the chair in experimental physics and astronomy at the University of Padua (where he had succeeded Nicola Bernoulli), had taken a position similar to Lodoli's. But although he was concerned with reconciling Vitruvius with Newton ("iuxta textum Vitruvii et mentem Neutoni"), his work was focused on engineering (resistance of materials) and not on issues of architectural form and style.[25]

It is in this milieu that Teofilo Gallaccini (1564–1641), a long dead and virtually unknown Sienese polymath, suddenly emerges from obscurity to be claimed as authority by Pompei, Lodoli, and the larger community for which they spoke. Gallaccini's manuscript treatise "Degli errori degli architetti" (On the errors of the architects) (c. 1625) had only recently come to light and its critical and prescriptive tone had immediately attracted attention. There is evidence that Alessandro Pompei became aware of this text in 1739 through correspondence with the Sienese cleric Giovanni Girolamo Carli.[26] It is thus very likely that news of Gallaccini reached the Veneto via Pompei, and that Lodoli through his connection to Pompei's Anglo/Venetan circle would have known of him during the heyday of his teaching. By 1761 the manuscript was in Venice in the library of architectural impresario Consul Joseph Smith and available to his large circle of friends, among whom were Memmo, Lodoli, and Poleni. The publication of the *Errori* in 1767 (funded by Smith) caused something of a stir since Temanza recounted the events leading up to it in a letter to Milizia.[27] By 1771 the assimilation of Gallaccini was so complete that Smith's architect Antonio Visentini appended his own images of "decadent" modern architecture to a new edition of the *Errori*.[28] Belying the passage of 150 years, one argument flowed seamlessly into the other, apparently unhampered by any hermeneutical barriers (Figures 1, 2).

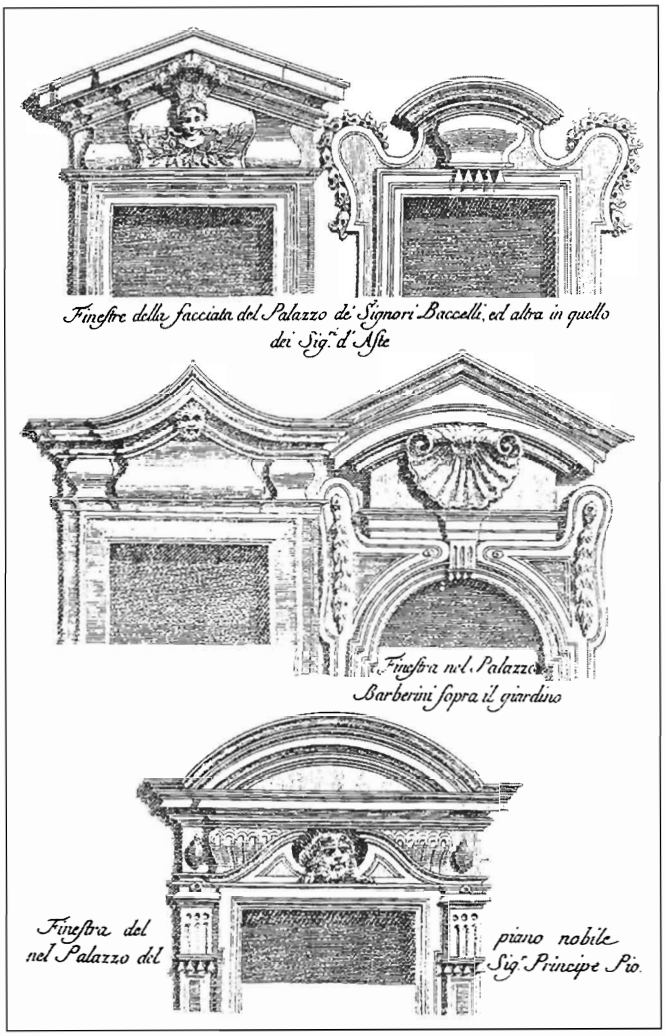

FIGURE 2: Antonio Visentini, *Osservazioni che servono di continuazione al trattato di T. Gallaccini* (1771)

Gallaccini's work had sparked interest not only in the Veneto but also in his native Siena where a number of historians attended to his life and oeuvre at some length. Nor was this activity unknown in Venice. Count Antonio Pecci's biography of Gallaccini was published with the first edition of the *Errori*.[29] Guglielmo della Valle's detailed description of Gallaccini's corpus of theoretical works, published in his *Lettere sopra le belle arti* (1786), had first been written as a letter to none other than Memmo.[30] Finally, Angelo Comolli, a collaborator on Memmo's publications, added more biographical detail on Gallaccini in his *Bibliografia storico-critica* of 1792.[31]

This register of reception is primarily of local historiographic interest, but it also reveals one arresting circumstance: that a significant group of architects, historians, and critics in Tuscany and the Veneto held Gallaccini in great esteem. This is remarkable and puzzling for two reasons. First, how can Gallaccini's work have appealed to both Pompei, who promoted the mimetic aesthetic of the Renaissance, *and* to Lodoli, who set himself up as the prophet of a new, scientific meth-

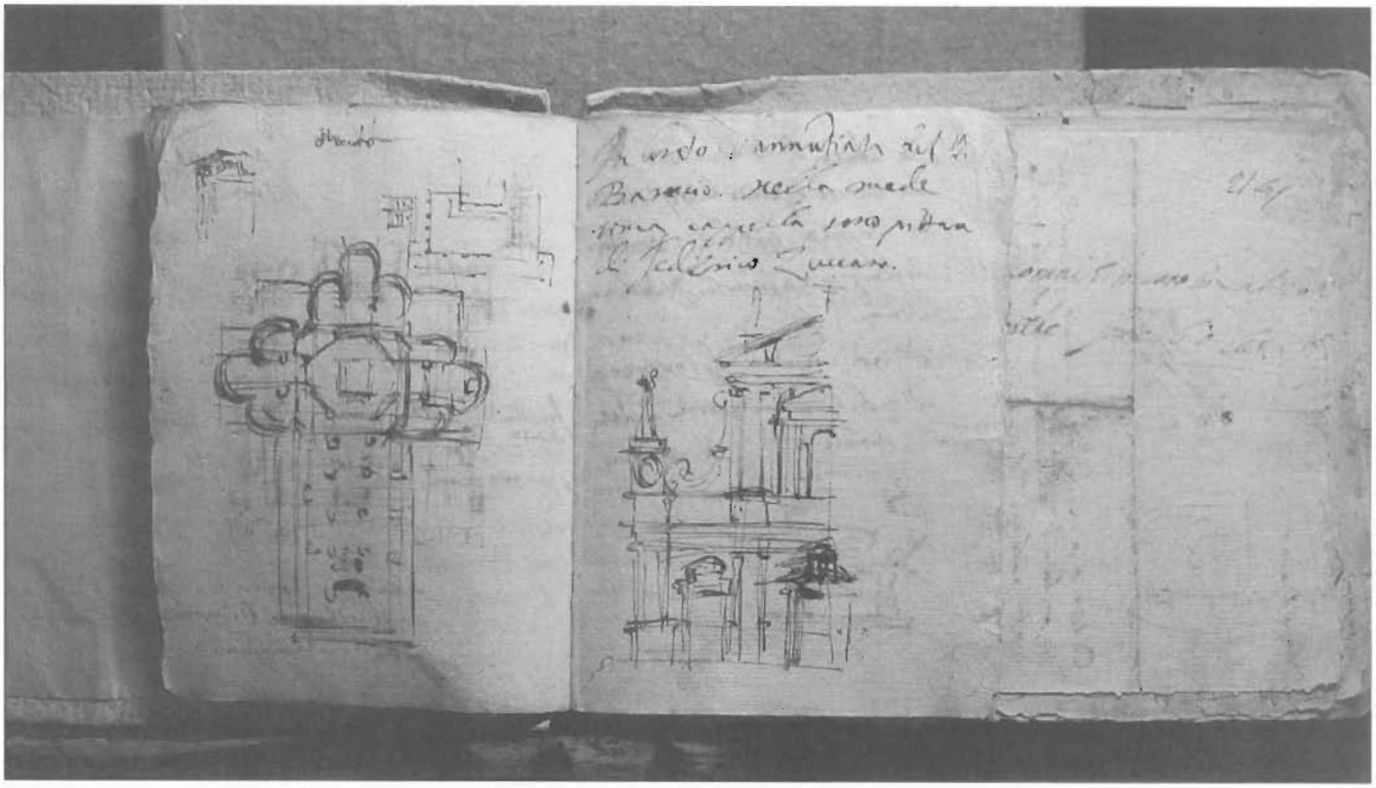

FIGURE 3: Teofilo Gallaccini, "Libretto contenente un cenno d'un suo itinerario"

FIGURE 4: Teofilo Gallaccini, "Trattato de capitelli delle colonne"

od?[32] Second, in Lodoli's (and Memmo's) case, this embrace of Gallaccini's ideas meant jettisoning the great text chain that came down from the Renaissance in favor of a virtual unknown; in the case of Consul Smith and his circle, it signified elevation to a status of equality with these texts.

According to his eighteenth-century biographers, Gallaccini was a professor of mathematics and philosophy at the University of Siena from 1621 to his death in 1641. He wrote much but published nothing in his lifetime. He certainly participated in the cultural life of his city as an active member of the Accademia dei Filomati;[33] he traveled through Italy and studied for several years in Rome, but otherwise he led an unexceptional life. His greatest claim to fame seems to have been his friendship with the Sienese Giulio Mancini, the seventeenth-century medic turned art critic who was active in Rome during the papacy of Urban VIII; Gallaccini dedicated his "Errori" to Mancini, who apparently read that text to the pontiff.[34] There is no building or architect (at least he mentions none) with whom Gallaccini appears to have been associated.[35] Unavailable (since unpublished) until his "discovery" in the mid-eighteenth century and returned to obscurity shortly thereafter, Gallaccini may seem unimportant.[36] But the question of why he held such great appeal for divergent groups of architects and theorists in the eighteenth century is significant because it forces us to rethink how we write the history of architectural theory and define its relationship to practice. Does history proceed by caesuras, ruptures, and paradigm revolutions, as Lodoli held and as modernist theory construed? Is there no continuity between the body of theory developed in Italy in the Renaissance and that of the Baroque and the Enlightenment world beyond it?[37] And have our disciplinary biases—to concentrate on treatises connected to major building careers and/or campaigns—led us to neglect the interstices, the very sites where transition and transformation in the discourse took place?

The Corpus

If Gallaccini's uneventful life led to his relative obscurity, it has also paradoxically provided the conditions for overcoming it. Most of his written oeuvre was preserved, and as a full corpus it offers a unique opportunity to observe the place of architectural theory in seventeenth-century culture as well as the forces that impinged on its making. As his biographers contended and the surviving manuscripts confirm, Gallaccini's architecture-related work was vast and the subject seems to have occupied him throughout his life. Thus, for his "Errori" of 1625 he certainly drew heavily on notes taken while traveling through Italy between 1610 and 1612. The pocket sketchbook that documents this trip contains itineraries, comments, accounts, building plans, sections, and details as well as whatever else struck his fancy—images of all kinds, including coats of arms, armor, inscriptions, and so on.[38] Gallaccini's quick but accomplished sketches testify to an experienced eye and hand, to a remarkable ability to distill essential visual information, and to careful, direct experience and analysis of monuments, all of which came to bear on his mature theoretical work of the 1620s (Figure 3). Ornament also attracted his attention. An extensive and heavily illustrated work on the capitals of columns and another (now lost) on the bases of columns show him engaging in a slice-by-slice analysis of the architectural frame (Figure 4).[39] We know that he also produced a work on good architecture, besides the one on errors. Giovanni Targioni-Tozzetti, who attended to Gallaccini's oeuvre in the 1770s, indicated that this text, "Il tempio o vero compendio dell'architettura," contained designs of two temples illustrating the "right way to build."[40] Finally, in 1641, the year of his death, Gallaccini was busy completing a treatise on perspective. This work also contains a significant architectural component in the form of an introductory subtreatise on the orders with a lengthy philosophical prologue on architecture (Figure 5).[41] But illustrated treatises were not his only contribution to the theory and criticism of architecture. Among his collected *discorsi* presented at the Accademia dei Filomati (and collected in 1630) there are several concerned with the arts: "Del disegno," "Della nobilità dell'architettura," "Dell'arte in comparation alla natura," and "In quanti modi sia intesa l'arte."[42]

However, the work of Gallaccini's that interested Memmo, Lodoli, Consul Smith, and Visentini most was his "On the errors of the architects" ("Degli errori degli architetti") of 1625.[43] Here Gallaccini sought to identify "la regolata architettura" (the architecture governed by rules) by combating abuses. The book is a long list of potential errors architects might commit and, more specifically, ones that they have already committed. Gallaccini mentions no names (indeed, he prides himself on his discretion), but he clearly dislikes Michelangelo's Porta Pia as well as some of the more recent work in Rome: the parapet sculptures on Saint Peter's Basilica and the Campidoglio palaces, the vaulting in the side aisles of Saint Peter's as well as its façade and side elevations. He is also critical of a variety of interventions to the Duomo and Sant'Agostino in Siena, as well as some less easily identifiable examples in various places throughout Italy.[44]

In some ways the *Errori* heralds the tradition of *parallèles* that we associate especially with Fréart de Chambray's 1650 *Parallèle des ancients et des modernes,* that is, the treatise tradition that emerged from the *querelle* between Ancients and Moderns at the French Academy focusing on the critique of contemporary abuses and the promotion of an alternative "right way." But, although Gallaccini may be seen to anticipate a trend that ultimately leads to Pompei's comparative method, he also recalls a venerable Italian tradition that goes back to Alberti.

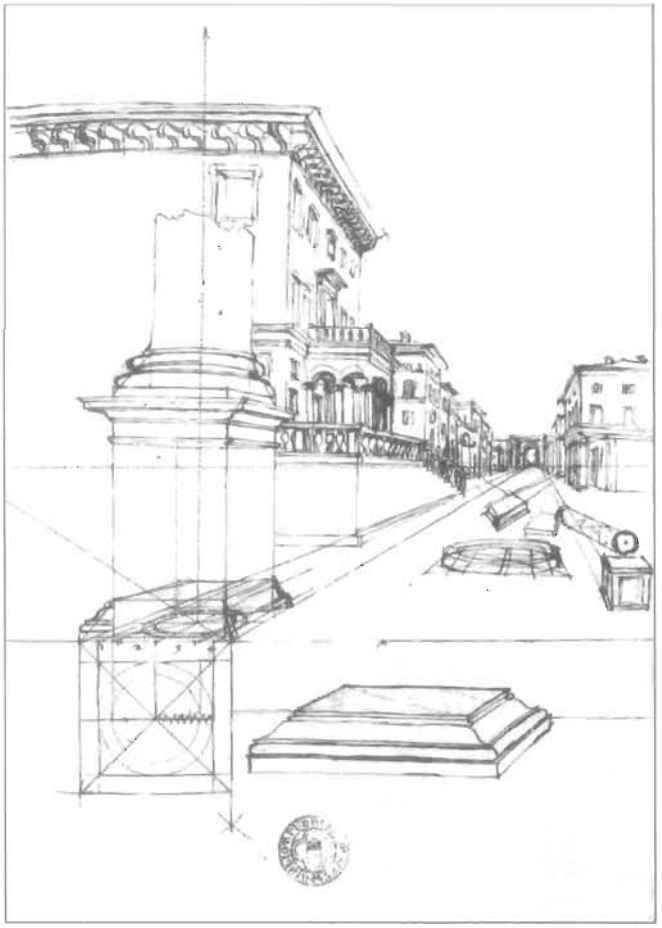

FIGURE 5: Teofilo Gallaccini, "Teoriche e pratiche di prospettiva scenografica"

Ever since the *De re aedificatoria,* every treatise contained a separate and almost obligatory chapter on the abuses of contemporary practitioners.[45]

Gallaccini, however, developed this theme into an entire book. A physician by training (like Giulio Mancini, whose example he probably follows), he not only introduced a diagnostic method of criticism, but he absorbed a genre of exposition from the sciences: the theater of poisons, the encyclopedia of diseases finds its architectural counterpart.[46] However, as his criticism of Michelangelo already suggested, much of what he says bears a strong resemblance to Palladio, Pirro Ligorio, and Scamozzi.[47] Thus, Gallaccini tolerates no projections in midair, no broken pediments ("a defective manner never used by the ancients"), no mixing of orders, no superfluities, in short, no "caprice" and no *fantasie,* no "barbarous practices," all of which he associates with the "silversmiths, woodworkers, engravers, *stuccatori,* and painters."[48] Evidently he distinguishes between those who paste and glue, who mold and varnish surfaces, from those engaged in a tectonic art such as architecture (Figure 6).

Clearly, the principal thrust of Gallaccini's criticism is the faulty representation of load bearing in the structural frame—whether real or ornamental. His emphasis on the importance of the "debito luoco" (right place) and on the negative effects of "rompimenti" (breaks) in the continuity of structure and ornament alike, lead him to conclude, like Palladio, that "in an architecture that imitates nature, one must not overstep *la necessità,* nor leave behind all that is necessary."[49] For readers like Pompei, Visentini, and Temanza, who were seeking to turn their contemporaries' attention to the architecture and implicitly to the theory of the sixteenth century, such comments must have been particularly resonant.

Yet, despite a strong resemblance, there is a subtle difference in kind between Gallaccini's treatise and those of his Renaissance predecessors. The architectural errors Gallaccini cites are interchangeably discussed with errors of building science; indeed, this contiguity seems to suggest continuity between them. To be sure, a discussion of materials had been an almost obligatory component of every architectural treatise ever since Vitruvius. But with Gallaccini we see a far greater concern with mechanics and its application to architecture. Much of his treatise concerns errors of construction, some of them quite specific (dealing with walls, foundations, excavation errors, and the like).[50] Most noticeable is his concern with structure and its real bearing ability, with the resistance of materials, and with the connections among members. For example, he attends to problems associated with imposing loads on existing masonry walls that are not designed to carry them; he stresses the role of corners as buttressing elements in buildings; he alerts his readers to the importance of preserving continuity among carrying members and draws their attention to the critical role performed by joints in this context.[51] Yet, within this same argument he turns to errors in ornament and admonishes that projections should not be used for effect but only for *necessità* where there is an

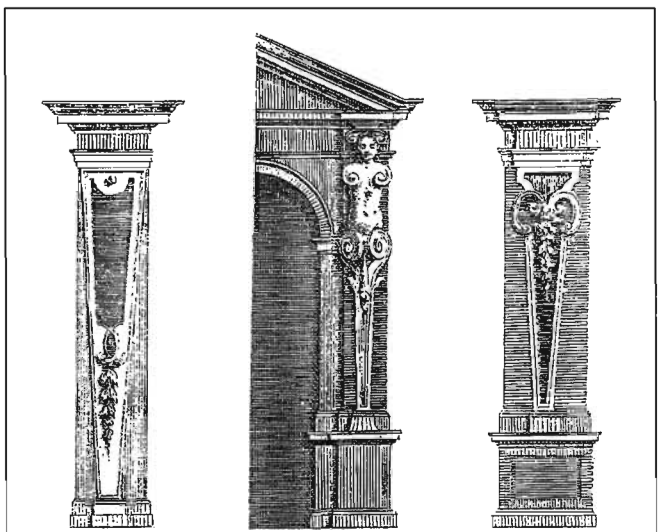

FIGURE 6: Teofilo Gallaccini, *Trattati sopra gli errori degli architetti* (1767)

additional weight to be carried.[52] Finally Gallaccini turns to materials and attempts to rationalize their use: for him stone ornaments should not look like ornament in wood or stucco, as they do, for example, on the façade and sides of Saint Peter's Basilica. "In stucco, wood and the like it is acceptable to engage in licence, since there the pieces are all attached and have no true connection with each other and the whole, are not born with it, but are all tied with straps and iron clamps and glue," he concludes.[53]

Science

Gallaccini's concentration on errors has prompted some scholars to see traces of a Counter-Reformation rhetoric in his discourse and to place his work in the tradition of Gilio da Fabriano's moralistic prescriptions for religious art in *Degli errori e degli abusi de' pittori circa l'istorie* (1564).[54] Others have seen in Gallaccini the first stirring of a classicist trend in criticism that would be consecrated later by Bellori and that Gallaccini himself derived from Mancini.[55] Indeed, the fact that Gallaccini dedicated the *Errori* to his Sienese mentor and friend may suggest that he felt a kinship of approaches as well as of ideas that justified such a gesture. Certainly, his brand of architectural classicism is in keeping with Roman work of around 1600, such as that of Onorio Longhi or Ottaviano Mascherino, who were part of Mancini's circle and with whom Gallaccini most certainly came in contact during his long sojourn in Rome (1590–1602).[56] Gallaccini's views may also share a common root with those of Scamozzi, whose own treatise—not coincidentally described by Manfredo Tafuri as the product of a "classicismo esasperato"—was decisively shaped by his exposure to Rome in the decade prior to Gallaccini's arrival there.[57]

However, the principal source for Gallaccini's views has been ignored. First and foremost he was a scientist. Giovanni Targioni-Tozzetti, who in 1780 provided most of what we know about Gallaccini's "Compendio dell'architettura," did so only by the way, for he was writing a history of science in Tuscany during the settecento, and in his narrative he dedicated a fair amount of space to Gallaccini. The bulk of the work is focused on Galileo and the Accademia del Cimento, and it is in this context that Gallaccini and other personalities who moved on its periphery figure most prominently.

Gallaccini's writings, now in the Biblioteca Communale, Siena, cover mathematics, mechanics, ballistics, astronomy, hydraulics, gnomonic, and medicine. This spectrum of sciences and the topics he covers—motion, weights, moments, leverage, free fall and centers of gravity, impact, the movement and trajectories of planets and comets, buoyancy—are precisely the issues that were at the center of scientific discourse at the turn of the sixteenth century and led to the important discoveries of the seventeenth.[58] Thus Gallaccini provides lengthy treatises on artillery and Niccolò Tartaglia's *Nuova scienzia* (c. 1632), which form a group with his treatise on fortifications (Figures 7, 8);[59] two treatises on geometry (on angles and the circle), to which group also belongs his commentary on Euclid's Book VI (c. 1626–1627);[60] a treatise on "the nature and force of moving water" (essentially on hydraulics) that shows interests also evident in his text on the fortification of port cities (1598–1603; Figure 9).[61] To these strictly scientific concerns also belongs his *libretti* on gnomonic that ties into his astronomical work on the "celestial world," on the poles of the earth and movements of the "orbi celesti," on the "scintillar delle stelle," and on the "lucidezza della celeste ragione detta Eterea" (Figure 10).[62] Most of this work also shows that he paid significant attention to measuring instruments.

If we consider Gallaccini's architectural treatises in the wider context of his whole oeuvre and of Galileian science in particular it seems less surprising that Lodoli should claim him. Indeed, Galileo loomed large on Lodoli's horizon. Memmo points this out from the beginning of the treatise; he himself had been reading Galileo's work with the Abate Ortez and had approached Lodoli, who had "before his eyes" the very same dialogues *(Dialogues Concerning Two New Sciences).* "He let me understand," Memmo writes, "that it would be very difficult for the scientific principles that Galileo discovered in his mechanics and those that he [Lodoli] had found almost simultaneously in architecture to be different from each other or even corollary."[63] Not surprisingly, Lodoli defined architecture as equivalent to the science of statics and (quoting Milizia) cited a formidable string of scientists who had written on hydraulics, mechanics, mathematics, optics, astronomy, and engineering—Bernard Forest de Belidor, Pierre Varignon, Nicola Bernoulli, Leonhard Euler, Philippe de la Hire, Emiland Gauthey—to support this claim.[64] "There are many others who in our century perfected mechanics in the steps of our Galileo—all works that are not even mentioned by our *professori architetti.*"[65] Stereotomy and the study of the resistance of materials are Lodoli's principal concerns, and Galileo is presented as the fountainhead for such knowledge. His findings, such as the superior bearing capacity of catenary and parabolic curves as compared with the circle, Lodoli argues, should be absorbed into architecture for building with more *robustezza* (strength) and *solidità* (firmness).

To be sure, Gallaccini was not among the trailblazing scientists that Lodoli quotes. Despite his progressive scientific concerns, his views on these matters seem to have been conservative, no doubt a consequence of the Jesuit education he had received in Rome in the 1590s. And indeed, the fact that he began teaching at the University of Siena in 1621, after its reform when appointments were politically determined, confirms that he followed the prevailing doctrine, or at least

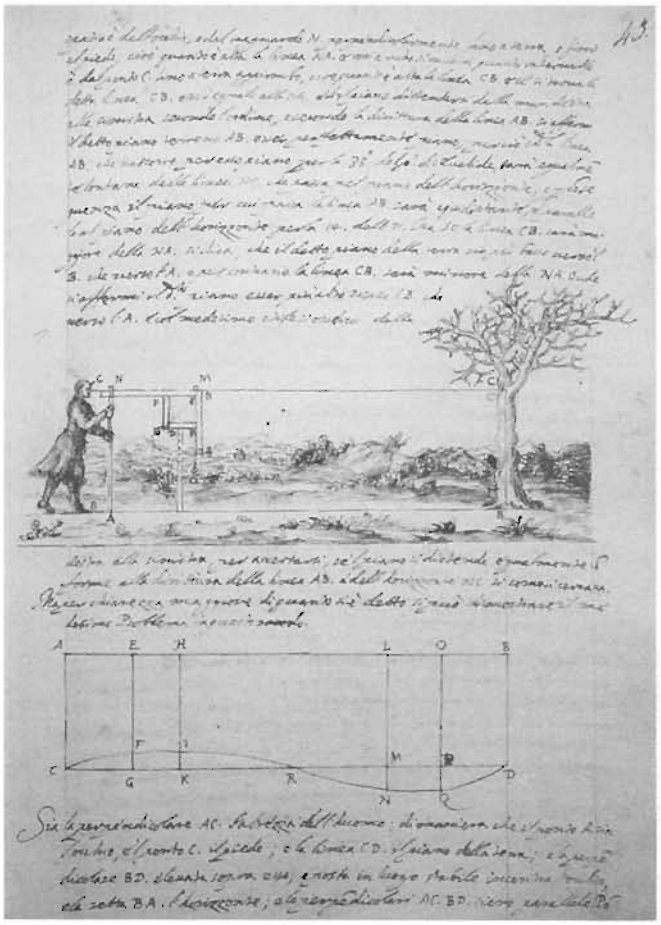

FIGURE 7: Teofilo Gallaccini, "Della nuova scienzia di Niccolò Tartaglia" (1632)

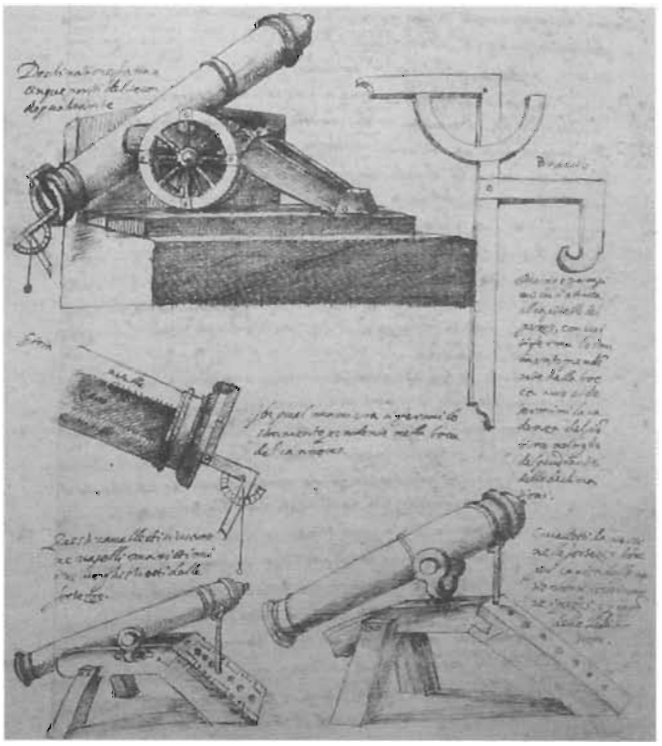

FIGURE 8: Teofilo Gallaccini, "Delle ragioni dei tiri. Dell'artiglieria"

that he did not actively contradict it.[66] The "bookshelf," or the authorities that he cites, includes the traditional ancient and late-medieval sources (Euclid, Archimedes, Aristotle, Averroes, Rabanus, Leone Ebreo, Aquinas, and Sacrobosco), Jesuit texts such as Cristoforo Clavio's, and the key sixteenth-century commentaries (by Federico Commandino or Guidobaldo dal Monte). Surprisingly, Galileo is mentioned only twice, although Gallaccini had met Galileo when the latter came to Siena to demonstrate the "macchie di luna," visible through his telescope, to Ascanio Piccolomini, archbishop of Siena and a friend of Gallaccini's (see Figure 10 for his illustration of the sightings).[67] Although he writes a commentary on Tartaglia's *Nuova scienzia* and quotes Girolamo Cardano, the more innovative (not to say subversive) modern authors, such as Giovanni-Battista Benedetti, Tycho Brahe, Johannes Kepler, and Copernicus, are conspicuously missing, as are references to the tradition of *de ponderibus* treatises, which goes back to Jordanus Nemorarius and prepared the terrain for the late-Renaissance work in dynamics.[68] Like his astronomy, Gallaccini's machines and port designs are not particularly original and depend upon Francesco di Giorgio, Bonaiuto Lorini, and Giovanni Battista della Valle.[69]

Evidently Gallaccini was no pathbreaker in the field of the

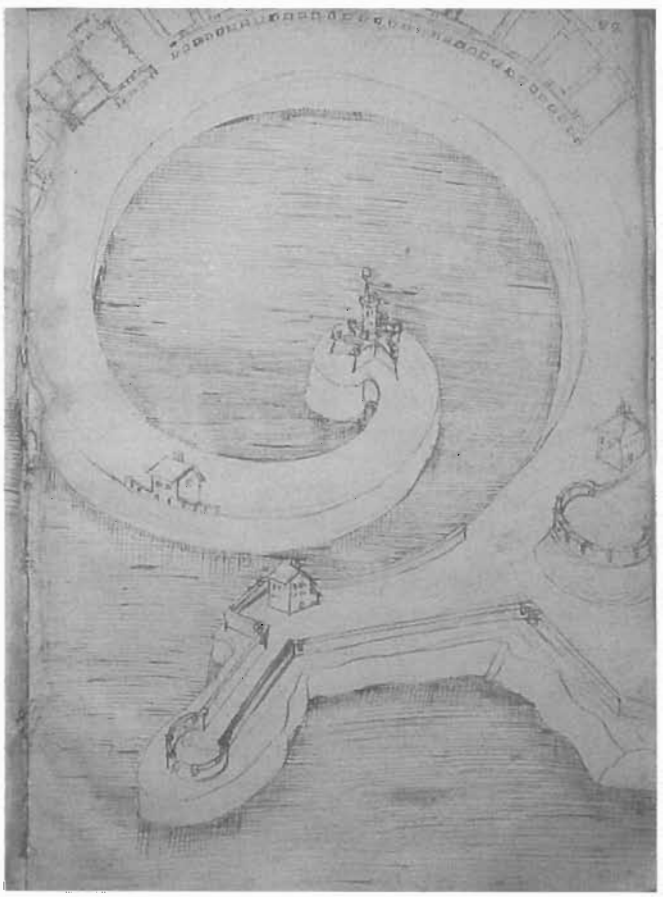

FIGURE 9: Teofilo Gallaccini, "Sopra i porti di mare"

FIGURE 10: Teofilo Gallaccini, "Il Mondo celeste, overo trattato di cosmografia".

sciences. Yet his concerns, the problems he engages, and the questions he seeks to answer—such as the path of *stelle errante* (wandering stars) or the movements of the *orbi celesti*—were the most topical issues of the day.[70] His less imaginative answers should not obscure the fact of his asking profoundly significant questions. Indeed, whether the Jesuits and the larger scientific community accepted Galileo's findings or not, they were nevertheless at work on the same phenomena. The solutions they proposed may have been less radical, and the debate may well have taken an ugly turn, but the very fact of a debate testifies to shared pursuits and vocabulary. The Collegio Romano, the University of Pisa, and the University of Siena all taught and offered chairs to scientists whose work set the foundations for Galileo. The treatises on weights *(de ponderibus)* and the treatises on movement *(de motu)* that emerged from these environments long before he published on the subject attest to this fact.[71]

Unlike the other scientists whom Lodoli claimed as authorities, Gallaccini had written on architecture and had shown that the two worlds were contiguous if not contingent. For one aware of his scientific oeuvre, Gallaccini's concerns with weight bearing in the "Errori" would have read as concerns with *real* support, not only its *representation* through a fictive system of signs. The fact that Gallaccini moved from a discussion of errors of construction to errors of ornamental composition as part of the same argument confirmed to readers like Lodoli that there was no caesura between what we see and what is there, between the facts of embellishment and those of construction and engineering. Gallaccini's long string of "errors" focused on the flawed engineering of buildings, and his scientific concern with the properties of materials added authority to such a reading. Naturally for Lodoli, who had himself written a (now lost) treatise on the strength of materials, Galileo and Gallaccini seemed to be speaking, if not with one voice, at least in the same language.[72] Galileo's statement in the *Dialogues Concerning Two New Sciences* (Proposition VIII) that the nature of materials plays as great a role as size in the structural soundness of an organism (or building) was well known to his generation; Poleni had quoted it in full in his analysis of the engineering of the dome of Saint Peter's.[73]

That there was much in Gallaccini's work to recommend him to Lodoli is clear enough. But was it unique and therefore tangible evidence of a rupture in the course of architectural

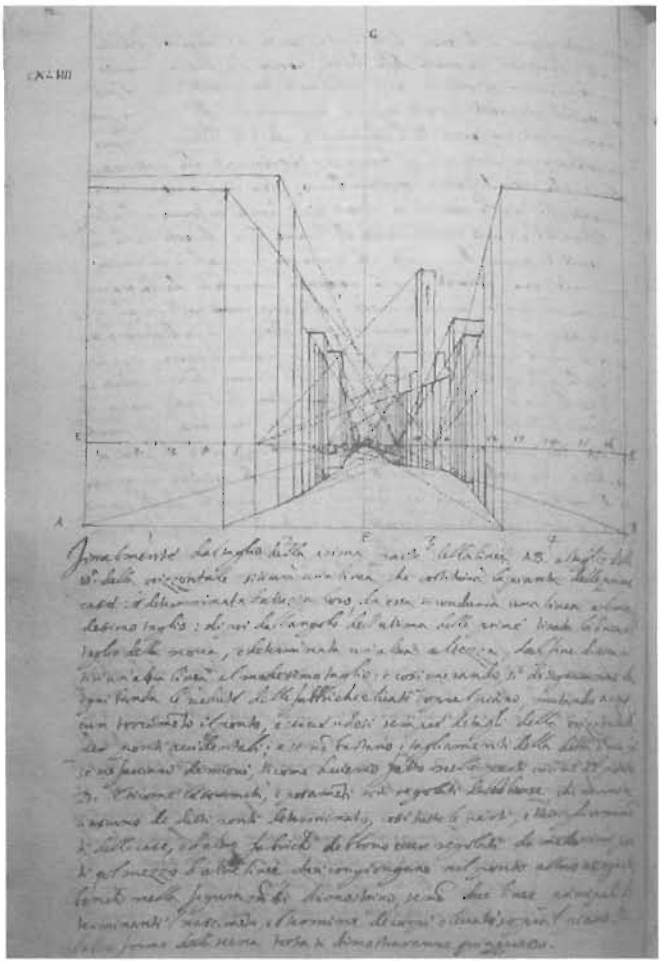

FIGURE 11: Teofilo Gallaccini, "Teoriche e pratiche di prospettiva scenografica"

theory between the Renaissance and the eighteenth century, or was his contribution to that discourse the barely visible tip of a larger cultural iceberg that we have not sufficiently attended to? In some ways, Gallaccini's concerns were not dissimilar to those of Daniele Barbaro, Cosimo Bartoli, Ignatio Danti, and Bernardino Baldi, or of Pietro Cataneo and Oreste Biringucci in Siena, that is, to the great universal minds of the sixteenth century who turned their energies with equanimity toward the arts, sciences, textual recuperation, philosophy, and occasionally even building.[74] In this sense he again seems to be part of the Renaissance world, just as his criticism of architecture seems to rehearse sixteenth-century adages. Indeed, architecture had always drawn on humanists, *letterati,* antiquarians, instrument builders, and mathematicians who carried important concepts from one milieu to another through language, methods, and the objects of their interest.[75]

But with Gallaccini we must also recognize a shift in kind. The intellectual searchlight he trains on the objects of his investigation illuminates a different set of contours. His focus is not that of his humanist predecessors—despite the obligatory historical and literary set pieces he produced (and was expected to produce) as an *academico* of respectable stature.[76] The driving concern behind Barbaro's and Baldi's work had been primarily recuperation: of ancient learning and material culture; of literary, scientific, mathematical, or architectural texts and the objects they describe—buildings, instruments, lifestyles, or tragedies.[77] But by the early seventeenth century the intellectual energy invested in reception had declined. And, as Amedeo Quondam has shown, there was a documentable trend to separate out science from the classical-humanistic unity of knowledge in the decades preceding the creation of the Accademia dei Lincei (1603).[78] Neither can Gallaccini be seen to fall into the category of builders and architects like Brunelleschi or Francesco di Giorgio who turned to the world of the *meccanico* for help with the specific problems posed by the construction process, nor into that of the architect/painter who needed to master science (geometry) in order to construct accurate perspective drawings.[79] With Gallaccini we witness a scientist addressing architecture.

Certainly, it is already evident from the time of Ignatio Danti, Barbaro, and especially Scamozzi that architecture was drawn into the sciences.[80] Leonardo Fioravanti's *Dello specchio di scientia universale* (Turin, 1564), Ignatio Danti's complex charts of related disciplines (*Le scienze mathematiche ridotte in tavole,* 1577), and Antonio Possevino's *Ratio studiorum* of 1593, in which architecture is disengaged from the visual arts and associated instead with the sciences, show how such views translated into curricula and comprehensive schemes for the classification of sciences.[81] When Federico Cesi appointed the Neapolitan architect Antonio Stelliola to the Accademia dei Lincei in 1612—thereby including him in the most avant-garde scientific group, whose ambition was nothing less than to reshape the educational curriculum across Italy—he consecrated a trend that had been evident for some time.[82] Such a move amounts to acknowledging a place for architecture in the constellation of sciences the Lincei embraced. Indeed, in his *Encyclopedia Pythagorea* (1616) Stelliola posits a supreme science from which all others draw. Among its more traditional branches (philosophy, music, mathematics), he lists architecture, the science of movement and centers of gravity.[83] Especially interesting in the case of the Lincei is the evidence it provides that the impulse to reclassify architecture came not from the leading architects of the time, but from the sciences.

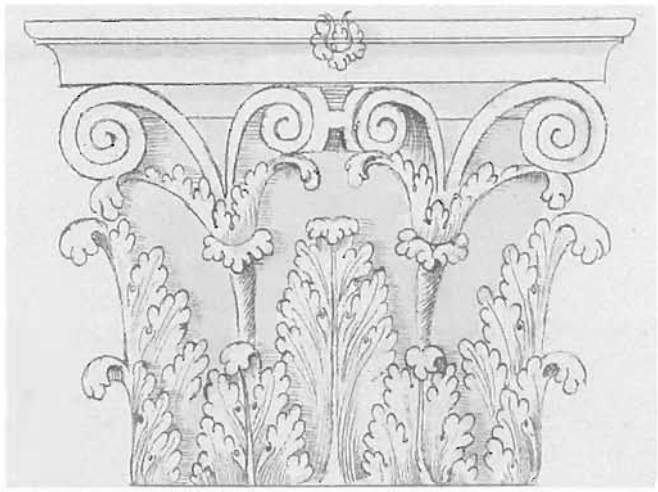

FIGURE 12: Ostilio Ricci, "Problemi necessari per l'architettura militare e civile" (1600)

Cesi's Lincei was formed one year after Gallaccini left Rome, and the architect Stelliola became a member some ten years later. It is possible that Gallaccini did not know much about the academy, even though Siena was still an important university center, especially for foreign students, and thus was on the dissemination path of discourse.[84] But whether or not he knew of this effort to harness architecture to the sciences, the fact that as a philosopher, mathematician, and scientist he turned toward architecture suggests that the conditions existed for such an annexation, that the discourses of both disciplines had moved close enough to each other for him to absorb them into his concerns. Always on the cusp between the sciences and the arts, architecture was now assimilated into the scientist's *paideia.*

In assessing the presence of a cultural iceberg, or rather the presence of an alternative site that affected the discourse on architecture, it is worthwhile to ask what Gallaccini intended to do with his work. It is reasonable to suppose that some of his texts were written for classroom use—"per uso scolastico," one cataloguer noted: those on Tartaglia, on Euclid, on gnomonic and geometry, perhaps even that on perspective, in which he shows far greater concern with the path that leads to

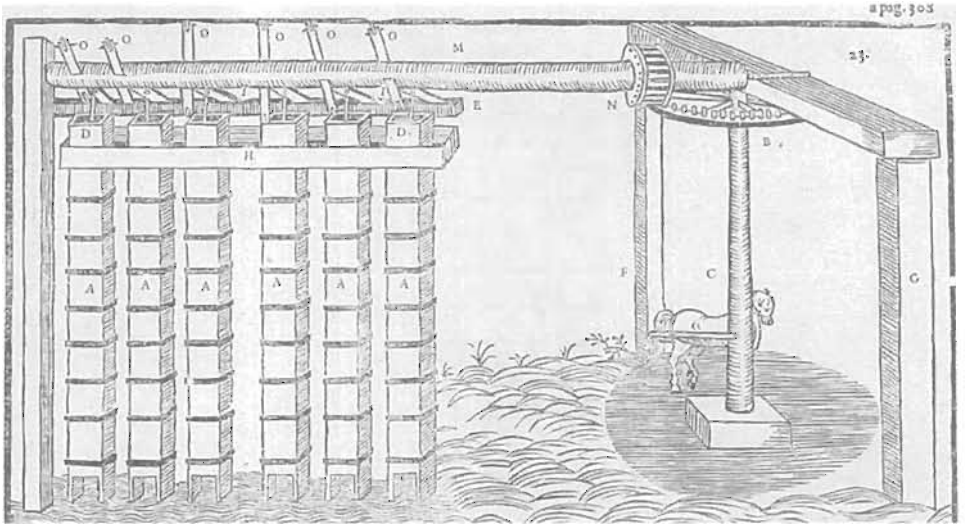

FIGURE 13: Alessandro Capra, *La nuova architettura familiare* (1678)

the accomplished scenographic *veduta* than does his contemporary Lorenzo Sirigatti (Figure 11).[85] The fact that most of his writings date from the period after he began teaching at the *studio* in Siena in 1621 may further confirm this view. Yet they do not appear to have been lecture notes, which usually opened with the formulaic "letto il . . ." (date of reading followed).[86] But, even if they were not actual lectures texts, we can assume that much in them was rehearsed orally since we do find important traces of his treatises in his *discorsi academici* for the Filomati where he was a frequent speaker. Thus, in addition to a small number of literary *discorsi* and two important ones on the arts, Gallaccini spoke on architecture, meteorology, astronomy, geometry, buoyancy, as well as on the imitation of nature, a discourse in which he concentrated on automata, mechanical toys and clocks, fountains, and moving statues—in other words, on motion, its imitation, and its origin.[87]

As a group these lectures testify to an interested audience, one accustomed to engaging these issues and evidently equipped to do so.[88] Indeed, for one student, Manfredo Settala, the memory of his university education in Siena in the early 1620s lingered on. His subsequent activities and interest in turning, optics, instrument making (especially telescopes and microscopes), clocks, and mirrors, which brought him so much fame in later years in Milan, go back to this period and offer another glimpse into the milieu he had been exposed to.[89] Fabio Chigi, the future Pope Alexander VII, who was Settala's companion when they were both students at the University of Siena, had been part of the same milieu and knew Gallaccini. This early education undoubtedly played a role in his interest in the arts (in 1625–1626 he drew up an exhaustive list of works of art to be found in his native city) as well as in architecture when he became one of the most important patrons of his generation.[90] Nor were the learned milieus of figures like Gallaccini, Settala, and Chigi outside of an architect's experience. As Joseph Connors has shown, Francesco Picchiati, Martino Longhi the Younger, and Borromini, for example, entered the world of collecting *mirabilia* and thus inhabited the same intellectual landscapes as the collectors Ulisse Aldrovandi, Athanasius Kirchner, or Settala.[91] Such circumstances testify to the place of oral communication, the exchange of objects, and the practice of collecting as alternate discursive sites that held a far more significant place in the architecture culture of this period than we tend to acknowledge.[92]

Nor was Gallaccini a lone trespasser from the sciences on the territory of architecture. Just as Galileo's discoveries emerged out of a larger ferment in the scientific world of his time, so Gallaccini's annexation of architecture as the praxis of his "celestial mathematics" was part of a larger tendency that gathered momentum in the eighteenth century and so connected to Lodoli and his world. Ostilio Ricci, mathematician at the Medici court and Galileo's teacher in Florence, wrote not only a heavily illustrated treatise on surveying around 1600, but also one on the orders in which he described himself as "architect" (Figure 12).[93] Pietro Antonio Barca, who wrote *Avvertimenti e Regole circa l'architettura civile* (1620), was by his own admission an engineer writing on the arts.[94] Giovanni Branca, who wrote a treatise on machines of 1629 focusing on the effect of different weights on moving gears, pulleys, and hydraulics, also published a *Manuale d'architettura breve* in the same year.[95] This work, which became the standard practical handbook for architects in the seventeenth and eighteenth centuries (with reprints in Rome 1718, 1757, 1772, 1783 and Modena 1789), includes algorithms, a treatise on numbers, and an exposition on the Golden Section. Indeed, foreseeing its success, Branca argued that his small-format book would become an indispensable tool and that "those who will carry this little book in their bag, will know much more than we do."[96] A few decades later, Carlo Osio in his *Architettura civile*

FIGURE 14: Teofilo Gallaccini, "Delle ragioni dei tiri. Dell'artiglieria"

(1641) made much of the *architetto scientifico* and included *dimostrationi euclidiane* for the benefit of such practitioners, emphasizing geometrical constructions at every turn.[97] Alessandro Capra's *La nuova architettura familiare* (1678) also looked to the scientific side of architecture, and included many chapters on "errors" in the manner of Gallaccini as well as a (rather fanciful) book on machines (Figure 13).[98] Probably the most interesting among these writers was Costanzo Amichevoli, who wrote an *Architettura civile ridotta a metodo facile* (1675) and an *Architettura militare* (1684). But this was his "architectural" pen name; under his real name, Padre Francesco Eschinardi, he was professor of logic, physics, metaphysics, mathematics, and astronomy at the Collegio Romano and an active member of the Accademia Fisico-matematica. As Eschinardi he wrote on *de impetu,* comets, hydraulics, mechanics, and optics and had much sympathy for the "new science" of Galileo.[99]

Superficially this stream may seem to be that of the "terrestrial" mathematicians and scientists, of those working on fortifications, hydraulics, and surveying in a political and economic climate that increasingly depended on this expertise. Such was particularly the case in Tuscany and in the north where flooding rivers (the Arno), a profusion of canals and irrigations systems (in the Po valley), the need for both land and water defenses (Venice), and a politics of territorial expansion and control (Tuscany) encouraged the development of these professions. But writers such as Antonio Lupicini, Vittorio Zonca, or even Cosimo Bartoli (who was sending back to Florence information regarding the latest water-draining machines in use in Venice) were not concerned with the theory of architecture or with its definition but with applied science.[100] Unlike them Gallaccini and his scientist peers, like the "celestial mathematicians" Cesi and Stelliola, though attentive to machines and hydraulics, were concerned with philosophy, with primary causes, with the definition of motion and forces, with astronomy, and it is from this vantage point that they sought to locate architecture among the scientific and philosophical disciplines. It is also important to note that despite resemblances, this is *not* the stream of architectural thought that flows out of Serlio and the sixteenth-century Vitruviana of Barbaro and Scamozzi inflected by the new scientific interests

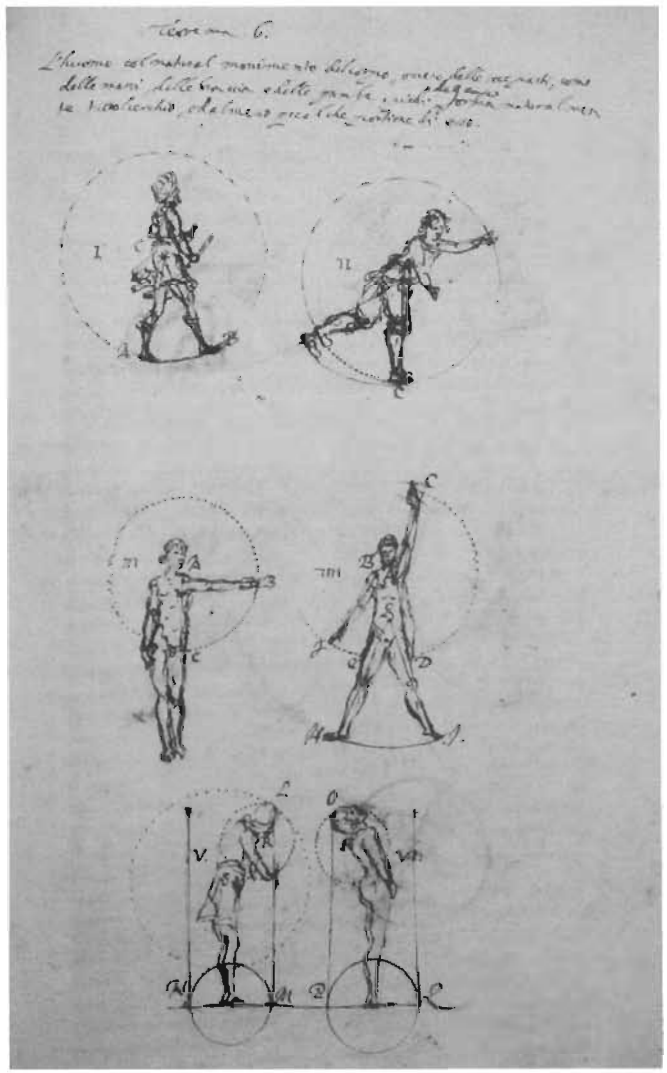

FIGURE 15: Teofilo Gallaccini, "Della natura del cerchio e del operazione del compasso"

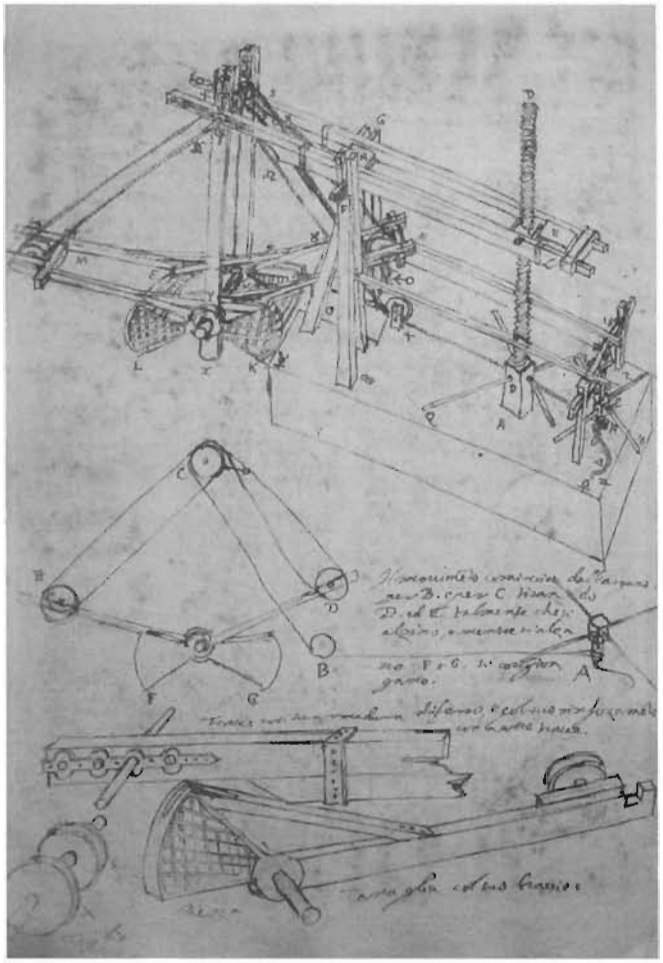

FIGURE 16: Teofilio Gallaccini, "Sopra i porti di mare"

of the seventeenth century and that leads through Guarino Guarini to Bernardo Vittone and Francesco Maria Preti. In other words, it is not the stream of architectural treatises conceived by architects that included increasingly sophisticated chapters on geometry (and algebra in Vittone's case).[101] Instead, it is a stream that runs parallel to it, that originates with the sciences and that makes place for architecture among them and constitutes the early stirring of its subsequent separation from engineering. In this sense Lodoli is very much a member of an Italian "text chain" that ties the architectural theory of the Renaissance and the Baroque with the world of the Enlightenment; he was a participant in an ongoing discourse, not the complete original that he presented himself to be. It is also important to point out that this is a different lineage from Pompei's, whose own brand of criticism is referable to a tradition developed in the visual arts, and goes back to Bellori's distinction between substance and surface, *disegno* and ornament, color and brushstroke, and more generally, between respect of ancient sources and ephemeral fashion.[102] That Lodoli was aware of this difference in a way that his predecessors had not been signals that the moment of bifurcation in the discourse had come.

Imitatio

However, the *imitatio* component in Gallaccini's thinking that Pompei rightly seized upon cannot be ignored; nor can it simply be attributed to an obligatory rehearsing of old maxims that survived in architectural criticism from text to text. Yet from a modern perspective it seems strangely at odds with his otherwise scientific orientation. Indeed, however disparate his interests, one overarching theme in Gallaccini's scientific work is the mathematization of the physical universe, that is, the translation of the movement of the stars, of the human body, of water, of light and shadow, of projectiles, of sight into mathematically (geometrically) defined configurations. Into this category fall his treatises "Il Mondo celeste" (on the movement of the stars and on the movement of "stelle er-

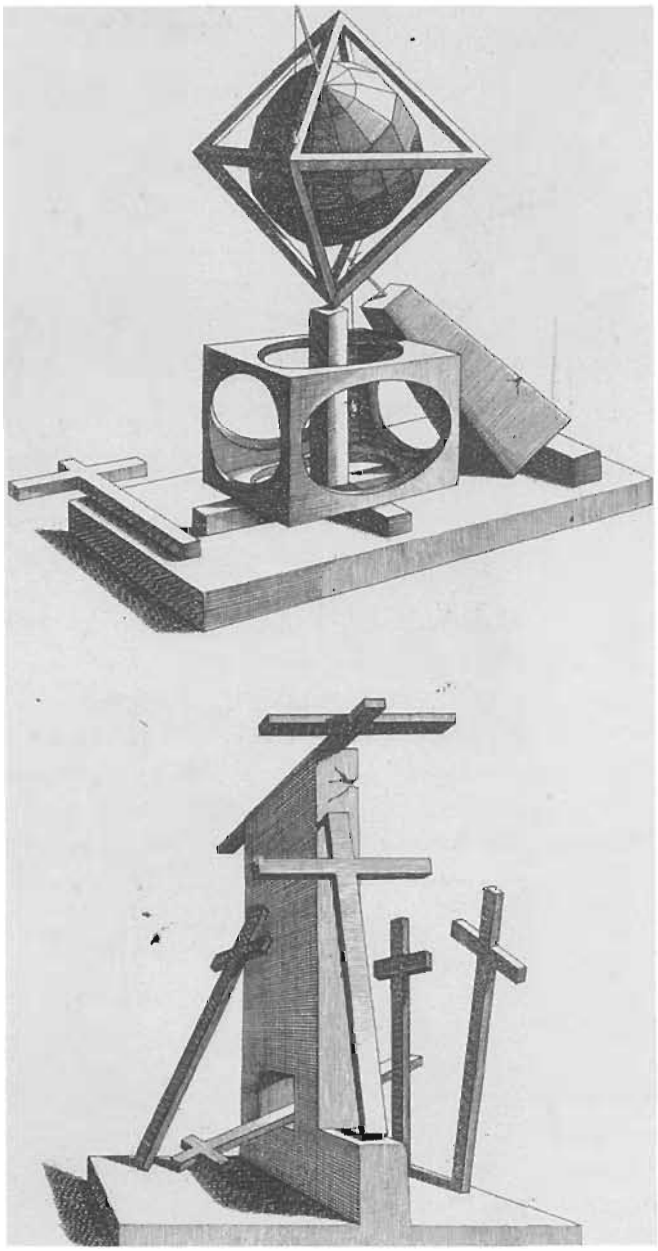

FIGURE 17: Lorenzo Sirigatti, *La prattica della prospettiva* (1596)

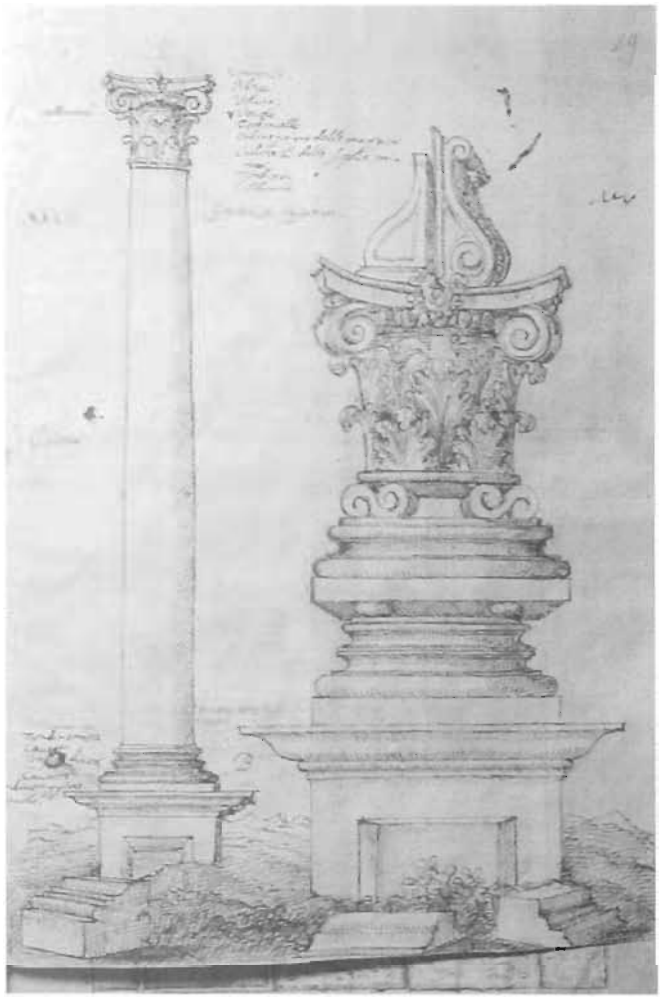

FIGURE 18: Teofilo Gallaccini, "Teoriche e pratiche di prospettiva scenografica"

rante"); "Della nuova scienza di Niccolò Tartaglia" and "La prospettiva scenografica" (on measuring sight); "Delle ragioni de tiri. Dell'artiglieria" (on projectile trajectories; Figures 8, 14); "Gnomonica" (on the movement of light and shadow); and "Della natura del cerchio" and "Perigonia," where he attends to the geometry of human movement (Figure 15). Such concerns show Gallaccini to be responding to the contemporary preoccupations with the tension between abstraction (as idealized mathematical models) and reality (as sensible experience).[103]

The invention, design, and illustration of machines, of perennial fascination to artists and scientists, was part of this same trend to convert the physical realm into mathematical/geometrical configurations.[104] Alberti said as much in his treatise: "Machines are comparable to animate bodies which are endowed with exceptionally strong hands and behave exactly like each of us in order to *move weights.* Thus in machines it is necessary to imitate the *dimensions* and *joints* of our own limbs which, thanks to the muscles, allow us to stand up, push, pull and carry weights" (emphasis added).[105] And indeed, many of the machine illustrations from the Renaissance, from Mariano Taccola through Leonardo to Bernardo Puccini and Giovanni Branca, display pronounced anthropomorphic features.[106] But a focused interest in movement and moments is far more noticeable in the later sixteenth century and early seventeenth than ever before, and it turns up in Gallaccini's oeuvre too (Figure 16).[107]

Indeed, within Gallaccini's interest in the mathematization of the universe one of the most pervasive themes is that of movement itself. His deep-seated interest is in mechanics, in the study of weights: suspended, projected across space as a result of violent or steady application of forces, or balanced, that is, in motion and at rest. Both his treatises on geometry and his work on ballistics and Tartaglia display these interests; in the former he explicitly defines his theme as "la misura del movimento" (the measurement of movement).[108] Thus, the study of mechanics in both its forms as statics and dynamics (even if as yet undifferentiated in contemporary science) lies at the root of Gallaccini's activities: the study of weights in disequilibrium means motion, and in equilibrium means rest. So pervasive is this concern in the contemporary culture that even a nonscientist like Lorenzo Sirigatti (whom Gallaccini

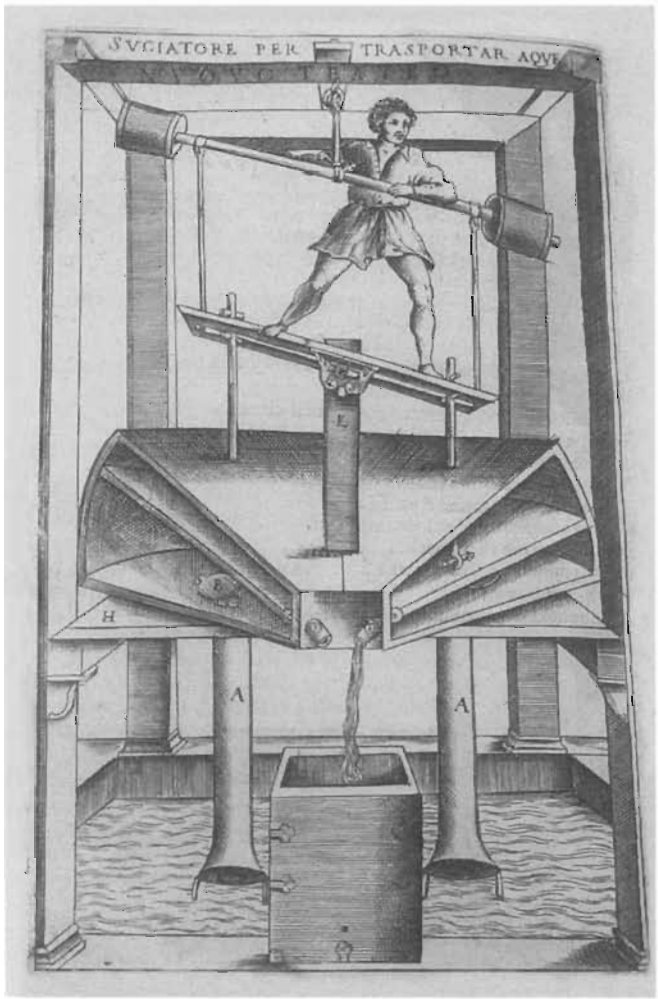

FIGURE 19: Vittorio Zonca, *Novo teatro di machine et edificii* (1607)

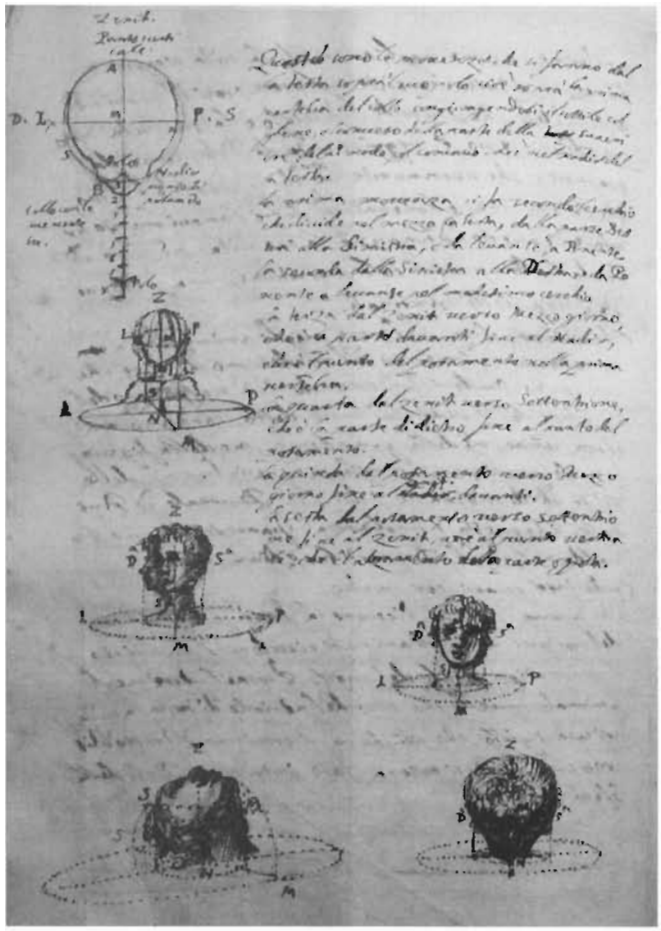

FIGURE 20: Teofilo Gallaccini, "Il Mondo celeste, overo trattato di cosmografia"

quotes and greatly admires) displays his bravura pieces of perspective as piled-up forms sustaining and thus displaying a fragile equilibrium, much like Gallaccini's dissections of the orders for his own perspective treatise (Figures 17, 18).

Gallaccini's interest in hydraulics can be seen to fit the same pattern: on the one hand, it was a natural enough concern, particularly in Siena where a sophisticated water-channeling system that crisscrossed the city had existed since the trecento and required maintenance and improvement; on the other hand, it can be seen as part of his larger investigation of the laws governing movement.[109] His *discorso* on the imitation of nature, in which he concentrates on the movement of clocks and water-driven automata, is evidence of a similar act of attention and fits in with the period fascination with the work of Hero of Alexandria *(Pneumatica* and *Automata)* and Pappus.[110]

Perhaps the most singular feature of Gallaccini's work is his use of the human body as principal tool to visualize movement. Here another facet of his scientific activity came into play: his medical training at the Ospedale della Scala in Siena.[111] According to his biographers, medicine attracted Gallaccini throughout his life and he was reputed to have written a treatise on anatomy and to have contributed to Valverde de Hamusco's *Anatomy,* presumably one of its later editions.[112] Significantly, his medical expertise was accompanied by a great interest in *disegno.* After completing his studies in Siena, Gallaccini moved to Rome in order to learn (among other things) *disegno.* It may be that he already had contacts in the art world of Siena, since the painters Bonaventura Salimbeni, Lippo Vanni, and Rutilio Manetti were part of Mancini's circle when he resided there.[113] However, Rome left a much deeper imprint on Gallaccini's artistic education. Since he was a physician and a friend of Mancini's, we can assume that he was a member of Mancini's circle and that he met Michele Mercati, author of the famous *Metallotheca,* and the architects Ottaviano Mascherino and Onorio Longhi.[114] Such contacts also meant ties to the Accademia di San Luca, where the latter two where members and *principii;* indeed, Gallaccini's own discourse on *disegno* clearly shows his familiarity with issues debated there in the 1590s and confirms ties with this milieu.[115]

It is particularly striking that Gallaccini's acquaintance in Rome linked him not only with representatives of the arts—critics, academics, or artists—but also to people like Mancini or Mercati, who, like himself, traversed from the sciences to the arts.[116] As we have seen, the harnessing of the arts by the

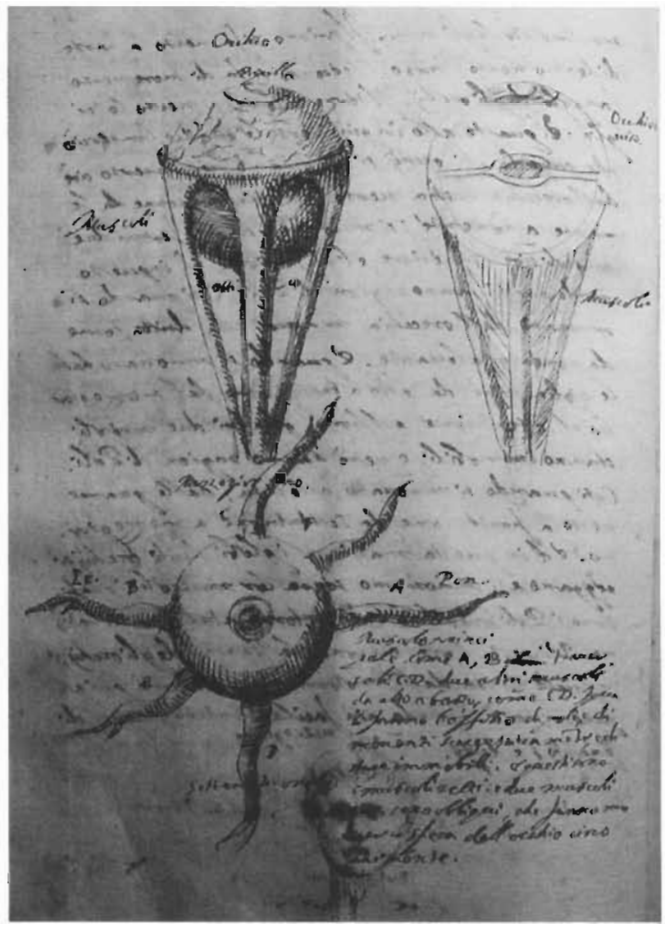

FIGURE 21: Teofilo Gallaccini, "Il Mondo celeste, overo trattato di cosmografia"

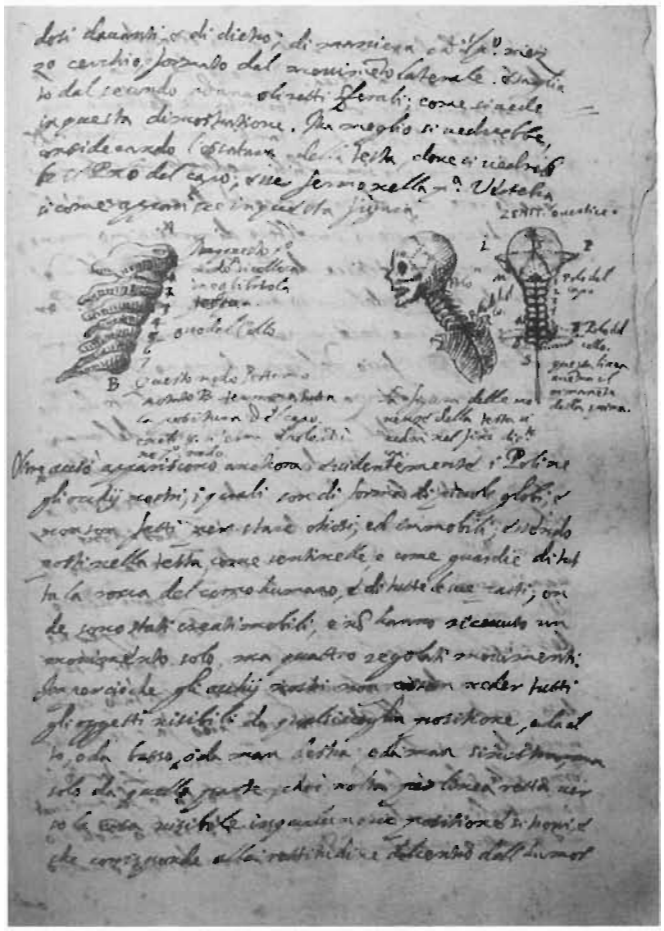

FIGURE 22: Teofilo Gallaccini, "Il Mondo celeste, overo trattato di cosmografia"

sciences was an important feature of intellectual life in Rome circa 1600; and the membership of Cesi's Lincei was only one of many sites of overlap. As David Freedberg has shown, new techniques of observation and the ensuing new systems of classification called for particular techniques of representation at the Lincei.[117] But they also required artistic virtuosity. And this was true not only of the natural sciences but also of mathematics. In Gallaccini's own words, *disegno* is necessary "to the *intelligenza* of mathematics because everyone's *ingegno* is insufficient to see the lines, figures, and bodies and their formation. And *disegno* alone, and no other art, can form all the figures *[cose]* of the mathematician without committing any errors. And the mathematician uses it as a tool to make up the figures *[figure]* he needs so as to explain and solve every demonstration, since he needs a sensual example *[un esempio sensoso]* and one easy to understand."[118] This statement is radically different from Leonardo's argument that painting is "truly science and the legitimate daughter of nature" because it "examines all qualities of forms: the sea, lands, animals, plants, flowers," in other words, because it allows us to record empirical observation.[119] Gallaccini, by contrast, is talking about the relationship between visual eloquence and abstraction.

If we compare Gallaccini's scientific treatises after his return from Rome with the work of others, such as those of his fellow mathematicians, or even Vittorio Zonca's virtuoso illustrations of real and fictive machines, it is clear that he put his *disegno* experience to work (Figure 19). But Gallaccini did not use the representation of the human body in motion only to *illustrate* the movement of the earth, the rotation around its axis, the geometry of the circle and of angles, the mechanics of weight displacement, and the connection of parts in architecture; he used it to *understand* these motions and these connections (Figures 20, 21). In his treatise on capitals, he wrote: "If we look at the joining of the bones, will we not see a perfect architecture?" Although this recalls Alberti's analogy between architecture and the human skeleton, Gallaccini takes it in another direction. The human body is like architecture because "every joint is placed in its right place, and is of such shape that it facilitates a stable, particular, and varied movement for each member; moreover, every connection has its own proportion, number, and form that allows it to perform its natural movement."[120] Mechanics, medicine, and *disegno*—focused on the human body, especially in motion—thus come together (Figures 22, 23).

Consistent with this view is Gallaccini's concern in the "Errori degli architetti" with "the breaks in the bearing sys-

FIGURE 23: Teofilo Gallaccini, "Perigonia, overo degli angoli"

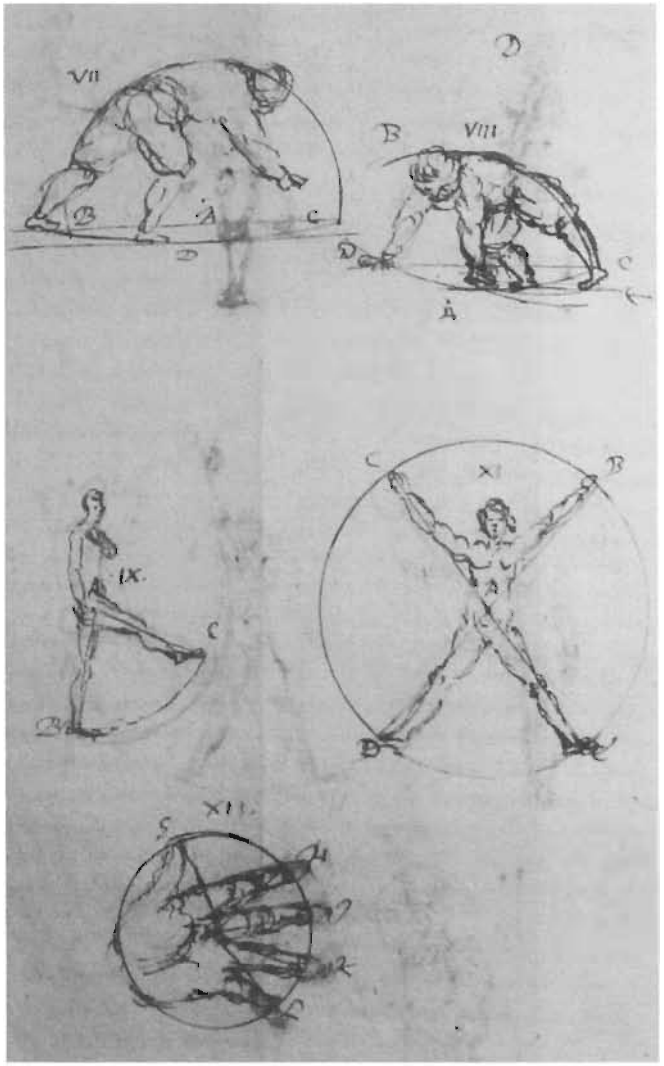

FIGURE 24: Teofilo Gallaccini, "Della natura del cerchio e del operazione del compasso"

tem" *(rompimento della pietra),* with the "unbroken connections between ornament" *(continuazione degli ornamenti),* and with joints (all instances of *congiugnimento*), all of which he refers to the human body. Time and again he speaks of the "bone structure" *(ossamenti)* of a building or architectural member.[121] His "sensual example" *(esempio sensoso)* could thus not have been better chosen, better or more convincingly drawn. The body is not an analogy only; rather, its internal movement, its joining systems, its mechanical characteristics have become the vehicles for the explanation of scientific (engineering) principles (Figures 24, 25).

Gallaccini's approach is thus far closer in spirit to Galileo than to Alberti. Galileo, like Gallaccini, used human bones to illustrate a point about the resistence of materials: a regular person and a giant will require not only different-sized bones but also different bone material in order to support their respective weights.[122] Not surprisingly, it was a follower of Galileo's, Giovanni Borelli, who became the most prominent representative of iatromechanics, the science of mechanical biology, for he took the implications in Galileo's analogy to its ultimate conclusion in his *De motu animalium* of 1685 when he blended muscles with vectors, anatomy with mechanics (Figure 26).[123] For all three, Gallaccini, Galileo, and Borelli, *imitatio* still provides the means to eloquence. But, like his scientist peers and unlike Alberti, Gallaccini does not use geometry to explain the body; he uses the body to explain geometry and mechanics. Though his procedure resembles its Renaissance model, the resemblance is only superficial. Gallaccini uses the same tools, but he wrenches the discussion into another direction.

Whether Lodoli acknowledges it or not, *imitatio* is still part of Gallaccini's conceptual world, and the immediacy of the image is still an indispensable companion to abstraction. In a world in which algebra had not yet provided an alternative system of signs and language for explanation, *imitatio* continues to offer the only path to eloquence.[124] Thus, Gallaccini testifies to a complex knot of discourses and practices that converge upon architecture in the seventeenth century. These intertwined discourses moreover do not die out with him,

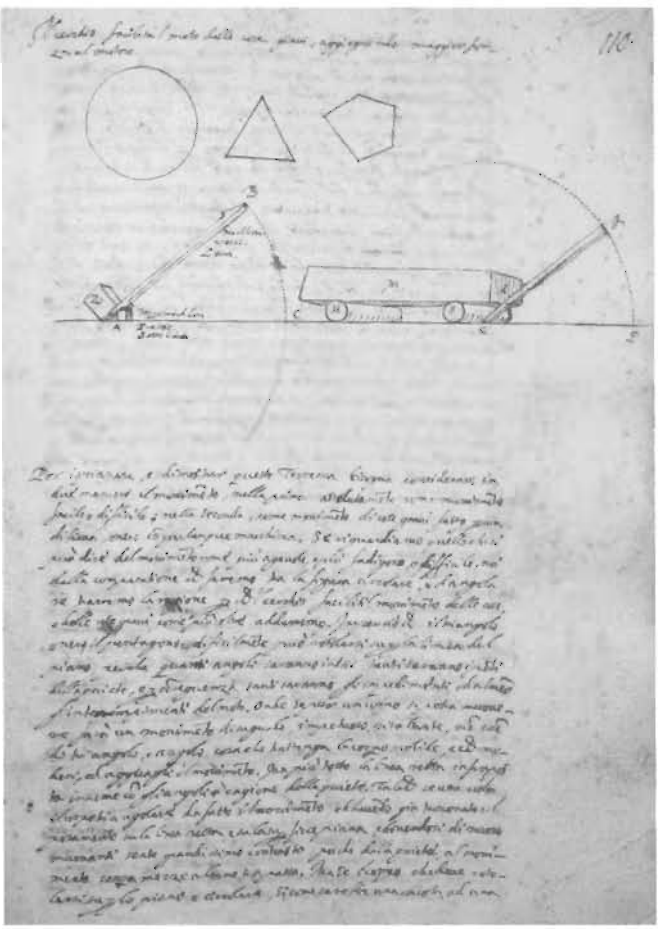

FIGURE 25: Teofilo Gallaccini, "Della natura del cerchio e del operazione del compasso"

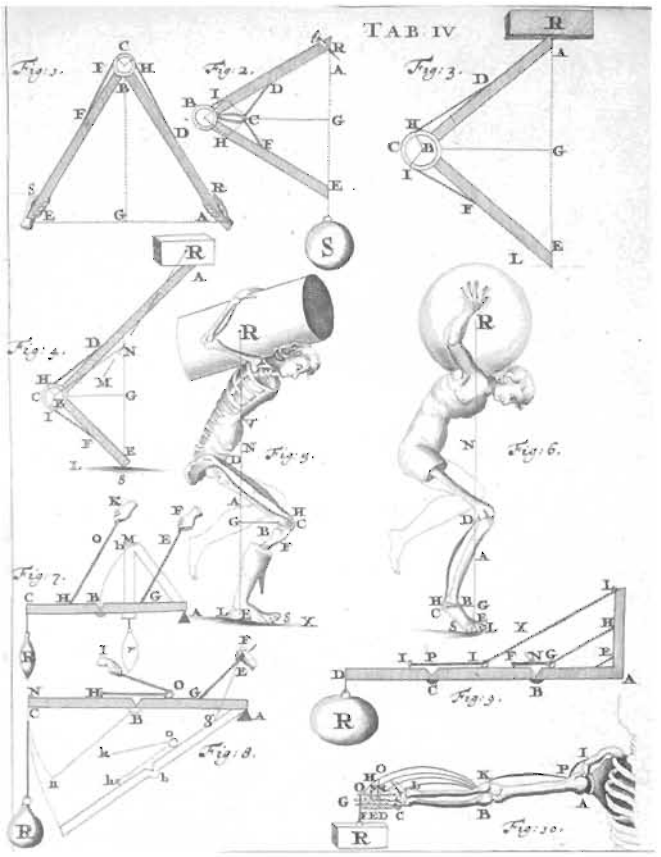

FIGURE 26: Giovanni Borelli, *De motu animalium* (1685)

but continue to lie at the core of Italian architectural theory well into the time of Lodoli. The alternative discourse Gallaccini reveals to us is a discourse that connected scientists and architects, academics and courtiers, and that set the stage for the theoretical revolution of the eighteenth century. In some ways this is a messy moment, when Galileo's "new science" and Giambattista della Porta's work on magic find equal welcome at the Accademia dei Lincei; when wonder, the marvelous, and hard scientific facts exist in harmony, as Datson and Park have shown; and when Renaissance imitation of the human body interacts with increasingly specialized work on mechanics and materials.[125] But precisely for this reason this moment is also so revealing because it displays a turning point when the eloquence of the body and mathematical formulas interact and illuminate each other. Both Pompei and Lodoli claimed Gallaccini, for he spoke to both. Reading him, we see how the discourse on weight bearing, familiar since Alberti and Palladio, could and did translate into something approaching engineering—apparently flowing effortlessly from one into the other without resistance until Lodoli claims the status of watershed. The particular road traced here from the self-conception of the architect as figural artist, to that of the architect as engineer, passed through the world of Galileo—and Gallaccini allows us to chart this passage. On the cusp between the world of mimesis and the world of abstraction, he shows us—with his successes, problems, contradictions, and all—how one translated into the other.

Notes

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[1] Andrea Memmo, *Elementi dell'Architettura Lodoliana, o sia l'arte del fabricare con solidità scientifica e con eleganza non capricciosa, libri due* (Rome, 1786), 13.

[2] For a detailed account of Lodoli's life and work and the most relevant bilbiography, see Edgar Kaufmann, Jr., "Memmo's Lodoli," *Art Bulletin* 46 (1964), 159–175.

[3] Michel Foucault, *The Order of Things* (New York, 1986).

[4] The relationship between Lodoli and Laugier is a vexed issue. Laugier published his seminal *Essai sur l'architecture* in 1753, before Lodoli's views had been committed to print by his students (the first to do so, though inaccurately, was Count Algarotti in his "Saggio sopra l'architettura" in *Opere* of 1756). However, references to Lodoli's teachings appeared in Father Sceriman's *Viaggi di Enrico Wotton;* moreover, the second edition of the *Essai,* which appeared after Laugier's visit to Venice, seems to contain changes that point to Lodoli's influence, if not to an actual pirating of his ideas. For a review of the literature, see Kaufmann, "Lodoli."

[5] For example, Kaufmann describes Lodoli as "extraordinarily courageous and prophetic" and compares him with Mies van der Rohe. See Kaufmann, "Lodoli," 171. Schlosser may be the origin of Lodoli's evaluation in modern scholarship: "Il Lodoli ci interessa perchè anticipa certi concetti moderni. . . . quasi un precursore solitario e dimenticato del Rumohr e di Gottfried Semper lo fa apparire la maniera con cui insiste sulla funzione del materiale nello stile . . ." Julius Schlosser Magnino, *La letteratura artistica* (Florence, 1977; 1st ed., 1924; rev. ed., 1964), 666.

[6] Memmo, *Elementi,* 13–14.

[7] Alessandro Pompei, *Li cinque ordini di architettura civile di Michele Sanmicheli non gia veduti i luce; ora publicati, ed esposti con quelli di Vitruvio e d'altri cinque* (Verona, 1735), 11.

[8] ". . . rivoltati in cent'angoli, ed in cento giri scontorto, onde gli si potrebbe addattare ciò che di quella serpe disse Virgilio, si ripiega, s'attorce, e si ragruppa." Ibid.

[9] Ibid., 13–14.

[10] "Una delle funeste cagioni di questo depravamento fu il desiderio di cercare, ed introdur novità, per altro lodevolissimo quando ciò tentisi da uomini d'eccelente ingegno, e di perfetto discernimento e giudizio . . . come appunto il Marino per questa inconsiderata vanità d'introdur nuove forme di pensare, e parlare nella Poesia, e ciò senza quel giudizio, che si conviene intraprendendo, quel gusto n'introdusse, che poi da' suoi seguaci, i quali (si come accade) il buono lasciarono ed il cattivo acrebbero a dismisura, fu sempre al peggio ridotto . . ." Ibid., 11. On the Roman Accademia dell'Arcadia, its conservative reform program, its many "colonies," among which an important one in Verona founded by Scipione Maffei, see Philip Sohm, *Pittoresco* (Cambridge, 1991), 200–204. Sohm notes that the analogies between the excesses of Baroque architects (Borromini's especially) and those of Marino and Marinisti were based on a deliberate misreading of history by Maffei, but that his belief in a period style was so strong that he felt justified in reordering historical events.

[11] "... freneticano angoli, spezzature e distorcimenti di linee, scompongono basi, capitelli e colonne, con frottole di stucchi, tritumi e sproporzioni." Giovan Pietro Bellori, *Le vite de' pittori, scultori e architetti moderni* (Turin, 1976; 1st. ed., 1672), 23–24. Bellori established a trend of criticism that was to culminate with the formation of the Accademia dell'Arcadia. On the whole, he had little to say on architecture, and its inclusion in his *Vite* is more a gesture toward a tradition established by Vasari. Most of his observations are located in the introduction. For good examples he points to the Greeks, Vitruvius, and sixteenth-century architects. Nevertheless, even if cursorily treated, the fact of architecture being included in his work signifies that he saw the same criticisms and recommendations to apply to all the arts—and it is in this spirit that he was read.

[12] Pompei, *Li cinque ordini,* 12.

[13] For an analysis of this aesthetic and its sources, language, and consequences, see Alina Payne, *The Architectural Treatise in the Italian Renaissance. Architectural Invention, Ornament and Literary Culture* (New York and London, 1999).

[14] "... le fabbriche restanti degli antichi Romani hanno di massimi difetti, benchè riconosciuti da'più autorevoli professori del buon tempo ..." Memmo, *Elementi,* 14.

[15] Ibid.

[16] Ibid., 184.

[17] Ibid., 196.

[18] "... la architettura ... dovrebbe essere una scienza, e non un arte semplice e materiale. Tutte le scienze includono cognizioni certissime di cose fondate sopra principii evidenti, e sulla dimostratione." Ibid., 199.

[19] Ibid., 201. The same criticism goes for Michelangelo, Bernini, and Borromini, who "reduced architecture to a plastic art." Ibid., 14.

[20] Tommaso Temanza, *Vita di Andrea Palladio Vicentino* (Venice, 1762).

[21] Tommaso Temanza, *Vita di Jacopo Sansovino* (Venice, 1752); idem, *Vita di Vincenzo Scamozzi Vicentino* (Venice, 1770); idem, *Vite dei piu celebri architetti e scultori veneziani che fiorirono nel decimosesto* (Venice, 1778). Francesco Milizia, *Le vite dei piu celebri architetti* (Rome, 1768); idem, *Principii d'architettura civile* (Finale, 1781); idem, *Memorie degli architetti antichi e moderni* (Bassano, 1781). This work was originally published anonymously as *Le vite de' più celebri architetti d'ogni nazione e d'ogni tempo precedute di un saggio sopra l'architettura* (Rome, 1768). The Renaissance architectural treatises continued to be published well into the eighteenth century, although Vignola's *Regola degli cinque ordini* was the most often reprinted (1732, 1736, 1739, 1748, 1763, 1783, 1787). Vignola (1774), Palladio (1774), Scamozzi (1764), and Chambray (1774) were published as part of the six-part *Bibliothèque portative d'architecture elementaire à l'usage des artistes* (Paris, 1764). The same trend is evident in criticism of Baroque painting and poetry and in the contemporary effort to publish and comment important Renaissance texts. See, for example, Giovanni Gaetano Bottari's publication of his collection of letters on art, his commentary to Raffaele Borghini's *Il riposo,* Giovanni Pietro Zanotti's history of the Accademia Clementina, Gerolamo Baruffaldi's history of Ferrarese painting, and Antonio Maria Zanetti's history of the Venetian school. On the history of eighteenth-century criticism of Baroque painting, see Sohm, *Pittoresco,* 201–202.

[22] For these milieus and their impact on architecture and criticism, see especially Manlio Brusatin, *Venezia nel Settecento: stato, architettura, territorio* (Turin, 1980), and Frances Vivian, *Il Console Smith mercante e collezionista* (Vicenza, 1971).

[23] In this context of a radical assessment of a tradition, Lodoli is among the first Italian critics to look favorably upon the Gothic.

[24] Temanza is more often the target of his attacks, but Milizia (who like him occasionally finds fault with the great Renaissance architects like Palladio) also receives his share. For criticism of Temanza's endorsement of *imitatio,* Memmo, *Elementi,* 33, 203; on Lodoli's fundamental disagreement with Milizia on the imitation of the primitive hut as the basis for architecture and on his emphatic statement that architecture imitates nature ("un arte d'imitazione"), see ibid., 257–259. Francesco Milizia, *Memorie degli architetti antichi e moderni* (Bologna, 1978; 1st ed., Bassano, 1785), xxvi.

[25] Poleni's most significant works are his *Memorie istoriche della gran cupola del Tempio Vaticano* (Padua, 1748) and his *Exercitationes vitruvianae, primae, secundae, tertiae* (Padua, 1739–1741). For a discussion of Poleni in the context of Enlightenment thought, see Brusatin, *Venezia nel settecento,* 181–201.

[26] Carli wrote a letter to Pompei on 15 November 1739. The letter is reprinted in Angelo Comolli, *Bibliografia storico-critica dell'Architettura civile ed arti subalterne,* vol. 4 (Rome, 1792), 252–258. In his letter Carli describes Gallaccini as professor of mathematics at Siena and author of forty-four treatises, among them a "Tesoro d'architettura" and a "Zibaldone dell'architettura." However, to Pompei he only describes the treatise on capitals (which he locates in the library of Giuseppe Maria Morozzi) and the treatise on errors (which he locates in the library of Canonico Antonio Amerighi).

[27] The evidence of Carli's letter refutes the scenario proposed by Temanza in his letter written to Milizia in 1769 where he describes how Pasquali had discovered Gallaccini's manuscript in a box of books coming from Siena. Temanza may have been wrong, or Pasquali may have wished to promote this story to benefit his publication. It is uncertain how long the manuscript had been in Smith's possession. The 1761 notice of its presence in his library was occasioned by the drafting of this will. On Smith's will, see Vivian, *Il Console Smith,* 127–128. On Lodoli's circles, see Joseph Rykwert, *The First Moderns* (Cambridge, 1983), 288–296, and Francis Haskell, *Patrons and Painters* (New Haven and London, 1980), 300–301, 320–322, and 337.

[28] Teofilo Gallaccini, *Trattato sopra gli errori degli architetti* (Venice, 1767). Visentini changed the title slightly from the manuscript ("Degli errori degli architetti per Teofilo Gallaccini insieme con alcuni insegnamenti d'Architettura"). The manuscript is in the British Library, King's 281. The second, enlarged edition with Visentini's contribution contains two parts bound into a single volume. Teofilo Gallaccini, *Trattato sopra gli errori degli architetti. Osservazioni che servono di continuazione al Trattato di T. Gallaccini di Antonio Visentini* (Venice, 1771).

[29] Giovanni Antonio Pecci, "Vita letteraria, compendiosamente descritta del celebre Teofilo Gallaccini lettore di filosofia e mathematica nella Senese Universita," Biblioteca Communale, Siena, Ms. A.III 10.nIV, 37r–40v. The manuscript has the following annotation: "Stampato nelle *Novelle Letterarie di Firenze* del 16 Febraio 1759." Subsequently it appears as the Introduction to the 1767 publication of the *Errori.*

[30] Guglielmo della Valle, *Lettere Sanesi del padre m. Guglielmo della Valle sopra le belle arti,* vols. 1 and 2 (Rome, 1785); vol. 3 (Rome, 1786). Della Valle gives a short notice of Gallaccini in volume 2 as well.

[31] Angelo Comolli, *Bibliografia storico-critica,* vol. 4, 252–258. This was volume 4 to his *Bibliografia dell'architettura civile* of 1788–1791. On the relationship between Comolli and Memmo, see Kaufmann, "Lodoli," 161.

[32] Such diversity of opinions within one critical trend was not an isolated fact. In the Accademia dell'Arcadia itself Vincenzo Gravina advocated purism while Lodovico Muratori held a tolerant view (though both were in agreement that Marinist decadence had to be eradicated). See Sohm, *Pittoresco,* 201.

[33] On the central role of the Accademia dei Filomati in the cultural life of Siena and its relationship to the (then dormant) Accademia dei Intronati, see Lolita Petracchi Costantini, *L'Accademia degli Intronati di Siena e una sua Commedia* (Siena, 1928), 102–106.

[34] Gallaccini notes at the inception of his work that it had been presented and read to Urban VIII in 1625 by Giulio Mancini. The connoisseur and physician Mancini had written a seminal work on artistic criticism, but it remained unpublished. For a discussion of Mancini's treatise, see the introduction in Giulio Mancini, *Considerazioni intorno alla pittura,* ed. A. Marucchi and L. Salerno (Rome, 1957).

[35] Patricia Collins notes that in a register of artworks present in his native Siena, Fabio Chigi lists an altar by Gallaccini. This is the only notice of such a work by him—Gallaccini never mentions it himself, nor does anyone else subsequently. See P. Bacci, "L'elenco delle pitture, sculture e architetture di Siena compilato nel 1625–26 da Mons. Fabio Chigi poi Alessandro VII," *Bullettino Senese di storia Patria* 46, 1 (1939), 197–213 and 297–337; and Patricia Collins, "A manuscript of an Architectural Work: 'Il tempio' by Teofilo Gallaccini," in *Florence and Italy. Renaissance Studies in Honour of Nicolai Rubinstein,* ed. C. Elam and P. Denley (London, 1988), 493–502.

[36] Other than an entry in the *Dizionario biografico degli italiani* by Daniella Lamberini and passing mentions in larger surveys of the eighteenth century, there are only four articles focused on Gallaccini. Eugenio Battisti, "Osservazioni su due manoscritti intorno all'architettura. I 'Sopra gli errori degli architetti' di Teofilo Gallaccini al British Museum di Londra," *Bolletino del Centro di Studi per la Storia dell'Architettura* 14 (1959), 28–38; Giuseppe della Fina, "Un taccuino di viaggio di Teofilo Gallaccini (1610)," *Prospettiva* 24 (1981), 41–51; Collins, "Il tempio"; finally, his manuscript "Sopra i porti di mare" was published as part of a larger study of port architecture from the Renaissance to

the eighteenth century: *Sopra i porti di mare. Il trattato di teofilo gallaccini e la concezione architettonica dei porti dal rinascimento alla restaurazione,* ed. G. Simoncini (Florence, 1993).

[37] On the pattern of negative criticism of the Baroque that affected modern history writing, see especially Werner Oechslin, " 'Barock': Zu den negativen Kriterien der Begriffstimmung in klassizistischer und späteren Zeit," in *Wolffenbüttler Arbeiten zur Barockforschung,* vol. 20 (Wisebaden, 1991), 1225–1254.

[38] Teofilo Gallaccini, "Libretto contenente un cenno d'un suo itinerario varie iscrizioni copiate . . . ," Biblioteca Communale, Siena, Ms. K.viii.4.

[39] Teofilo Gallaccini, "Trattato de capitelli delle colonne," Biblioteca Communale, Siena, Ms. S.iv.3. For a notice of his treatise on column bases, see Giovanni Targioni-Tozzetti, *Notizie degli aggrandimenti delle scienze fisiche accaduti nella Toscana* (Florence, 1780), vol. 3, 317–321.

[40] Targioni-Tozzetti, *Notizie.* Several sheets of this manuscript have been identified in a private collection, but the text does not survive. For an account of this material, see Collins, "Il tempio."

[41] Teofilo Gallaccini, "Teoriche e pratiche di prospettiva scenografica" (1641), Biblioteca Communale, Siena, Ms. L.iv.4.

[42] Teofilo Gallaccini, "Discorsi accademici," Biblioteca Communale, Siena, Ms. L.iv.1.

[43] Pecci dates the manuscript to 1621, De Vegni correctly to 1625. Indeed, Gallaccini states on the first page of the treatise: "Degli errori degli architetti per Teofilo Gallaccini insieme con alcuni insegnamenti d'Architettura per giovamento degli studiosi di tal professione, e di tutti quelli che hanno bisogno di fabbricare finito nell'anno del Giubileo 1625 e presentato a Monsg.or Giulio Mancini Medico e Cameriere Segreto di HS Papa Urbano VIII e veduta di sua Sanctità." Gallaccini, "Errori," n.p. Leonardo De Vegni's letter (23 March 1792) with this correction is published in Angelo Comolli, *Bibliographia,* 258.

[44] For example, ". . . non già con animo di formar la censura contro a ciascuno, ma con volontà d'insegnare col mezzo di tal cognitione la buona, e regolata architettura. Il che espressamente dimostreremo, tacendo i nomi degli architetti particolari . . . fuggendo di biasimare ciascuno." "Errori," 4v. For specific criticism of Saint Peter's, see ibid., 52v (where he criticizes the absence of perspectival adjustment in the design of the springing of the vaults in the aisles), and ibid., 63r ("secondo ordine della faccia & fianchi, & nelli ornamenti fra le colonne"); he also argues against the parapet statues at Saint Peter's and the Campidoglio palaces. He acknowledges that they give the façade more height, but is nevertheless critical because they cannot be maintained and because they are too far from view. Ibid., 67v. On the Porta Pia he does not name Michelangelo but he criticizes it as part of the chapter "Degli errori della mutation dell'ordine delle parti, dell'uso e della mala corrispondenza." Ibid., 78v. Finally, among the Sienese, he criticizes Bartolomeo Neroni's (Il Riccio) broken pediment in the chapel of the Quattro Santi Coronati in the Duomo. Ibid.

[45] The pattern was set by Vitruvius, who was unsparing in his criticism of contemporary practice. However, these passages tended to be located in the prefaces to his individual books, not in the body of the text itself as admonitions with specific recommendations attached to them. See, for example, Vitruvius, *De architectura,* II, praef., and VII, praef.

[46] Gallaccini is very explicit about the reasons that moved him to this choice of criticism vehicle: "Siccome nella medicina, scienza veramente salutevole, pregiatissima, e per l'origine sua divina, e più antica d'ogn'altra, natural magià maravigliosa, imitatrice della Natura, e sua ministra . . . una delle cose da essa proposte (benchè ci dispiaccia il nominarla, non che rivolgervi il pensiero) sì e *la cognizione de' veleni* . . . perciò che dalla cognizione di essi possiamo imparare a fuggirli per sicuro conservamento delle vite nostre; così nell'Architettura . . ." Gallaccini, "Errori," 4r (emphasis added). On Gallaccini's diagnostic method similar to Mancini's, see Briganti, "Osservazioni." For a discussion of the rise of the *theatrum* type of publication in the sciences and especially in medicine and its roots in a culture of collecting and curiosity, see Paula Findlen, *Possessing Nature* (Los Angeles, 1996). For a parallel example of the midwifely role of medical literature in the development of an architectural genre of publications, see Maurice Howard, "The Ideal House and Healthy Life: the Origins of Architectural Theory in England," in *Les traités d'architecture à la Renaissance,* ed. J. Guillaume (Paris, 1988), 425–434.

[47] In addition to the published treatises, Gallaccini may well have known Pirro Ligorio's work. Celso Cittadini, a close Sienese friend of Gallaccini's, had written a commentary on Ligorio, and it is very likely that his caustic criticism of faulty architecture, in particular Michelangelo's, was known to the two friends. See Celso Cittadini, "Annotationi sopra il libro delle antichità, & paradossi di Pirro Ligorio, di Celso Cittadini." On this work and its subsequent presence in Borromini's library, see Joseph Connors, "Virtuoso Architecture in Cassiano's Rome," *Cassiano Dal Pozzo's Paper Museum* (London, 1992), vol. 2 *(Quaderni Puteani),* 28. On Ligorio's critique, see David Coffin, "Pirro Ligorio and the Nobility of the Arts," *JWCI* 27 (1964), 191–211.

[48] Palladio's presentation of abuses is the most concise. He lists: broken pediments, interrupted columns ("colonne spezzate"), strongly projecting cornices, volutes ("cartelle") that are located in lieu of supporting members, etc. For the string of *abusi* that start being formulated by Alberti and receive a crisp and coherent formulation in the treatises of Palladio and Scamozzi, see Payne, *The Architectural Treatise.* Gallaccini advocates the "debita misura a ciascuno membro" and he continues: "Fra le membra esterne, e le interne delle fabbriche, cioè al'hora si erra nelle proporzioni, quando le parti interne non corrispondono alle esterne, nella misura, nel numero, nella positione, e nella forma." Gallaccini, "Errori," 56r. He is equally adamant about projections: "E quando tal volta si fa risaltar l'architrave delle porte quanto è la larghezza del vanno, ponendo ne sopra'l fregio, la cornice, il frontespicio, o qualche cartella, ad ornamento di finestra, o di qualche quadro; di maniera che tutto il peso mostra essere collocato sopra'l vuoto." Ibid., 59r. The "debito luoco" is as important as the "debita misura": when not respected "imperciò che oltre che fanno l'opere in tutto imperfette, & mostruose, levano a ciascuna il fine proportionato e naturale." Ibid. Broken pediments are as reprehensible as injudicious projections: "La questa maniera di frontespij cosi difettuosa, come si e dimostrato, non fu mai usata da gli antichi che non se ne trova essempio alcuno." Ibid., 62–63v. His most powerful salvo is against those who "diletarsi di trovare nuove inventioni, hora scemando, hora mutando, hora rompendo le membra principali: e finalmente convertendo ogni abuso in regola, e tralassando ogni dritta norma d'operare con buona ragion d'Architettura. Il che avviene dal non intendere che nelle fabbriche di qualunque maniera gli ornamenti son determinati di forma ne si puo inventare, se non si prende troppa licenza, e se altri non si vuole accostare al costume barbaro, a grottescamenti, a ghibirizzi, ed alle fantasie degli orefici, e degli argentieri, de maestri di legname, degli intagliatori, degli stuccatori, e de pittori." Ibid., 63r. Thus he is vehement against the use of herms and their derivatives since he finds their diminution toward the base inconsistent with the support of weight. Ibid., 65r. Finally, in chapter 9 he argues that any projection of ornament *(risalto)* of a column must have a reason, and must be necessitated by load-bearing conditions. Ibid., 74r.

[49] Gallaccini, "Errori,"1v. For Palladio's views on the *necessario,* see Payne, *The Architectural Treatise,* chap. 8.

[50] For example, see his chapter "Degli errori che procedono dalle nuove cariche, le quali si pongono sopra i muri vechij," where he discusses loads placed on brick walls. Gallaccini, "Errori," 95v.

[51] "La saldezza delle fabriche consiste negli angoli, che sono quelli che chiudono, stringono in se stessa tutta l'opera; onde la perpetuità degli edifizj è collocata negli angoli." Ibid., 64v. Moreover, many of Gallaccini's chapters focus on potential construction errors: "delle errori che' accadono nella mala scelta delle materie," "degli errori che occorrono nel fabricare," "degli errori che si fanno ne fondamenti," "degli errori che avvengono ne' coprimenti," "degli errori che accadono ne tagliamenti delle muraglie," "degli errori che accadono ne restauramenti," "degli errori de cavamenti sotteranei vicini a fondamenti delle muraglie," and so on. Ibid. "Con questo abuso s'accompagna il rompimento del fregio, e della cornice, per posare nel solo architrave alcuna cosa, come cartella, o scudo, o statua, o vaso, o altro, secondo l'umore dell'Architetto. Il che non si fa, senza notabile errore, perchè *si rompe la continuazione degli ornamenti, si disunisce il compartimento, e si scioglie il legame fra loro.*" Ibid., 45 and 63 r. (emphasis added).

[52] Ibid., 71v.

[53] Ibid.

[54] Collins, "Il tempio," 501 n. 15. For Gilio's treatise, see Paola Barocchi, ed., *Trattati d'arte del Cinquecento* (Bari, 1961).

[55] This position is taken by Battisti, Grassi, and Ackerman. Ackerman designates Gallaccini an early "classicist" who links Palladio with Mancini, Baroque classicism, and eighteenth-century neoclassicism. James Ackerman, "Palladio: in che senso classico," *Annali di architettura* 6 (1994), 14. Grassi

describes Gallaccini's work as "significativo precorrimento della poetica anti-barocca e razionalista predominante nell'età neo-classica." Luigi Grassi, *Teorici e storia della critica d'arte* (Rome, 1997; reprint of 1979 ed.), 14; Battisti, see n. 36.

[56] On Mancini and his circle, see Jacob Hess, "Note Manciniane," *Münchner Jahrbuch der bildenden Kunst* 19 (1968), 103–120. Hess argues that among the very few sources we know for Mancini's views on the arts Mascherino and Onorio Longhi are the most significant.

[57] Manfredo Tafuri, "L'idea di architettura nella letteratura teorica del Manierismo," *BCIS* 9 (1967), 367–384.

[58] For a general survey of the scientific climate at the turn of the century, see Richard Westfall, *The Construction of Modern Science* (New York, 1994; reprint of 1977 ed.); on these issues in Renaissance mathematics, see Peter Lawrence Rose, *The Renaissance of Mathematics* (Geneva, 1975).

[59] Teofilo Gallaccini, "Della Nuova Scienza di Niccolò Tartaglia Matematico Bresciano. Opera ridotta & esposta da Teofilo Gallaccini Matematico Senese nel 1632," Biblioteca Communale, Siena, Ms. L.iv.2.; idem, "Delle ragioni dei tiri. Dell'artiglieria," Biblioteca Communale, Siena, Ms. L.iv.2; idem, "L'idea della fortificazione ad uso dell'architettura militare e dell'arte della guerra, libro primo," Biblioteca Communale, Siena, Ms. S.iv.2.

[60] Teofilo Gallaccini, "Perigonia, overo degli angoli" (bound with "Della natura del cerchio"), Biblioteca Communale, Siena, Ms. L.iv.5; idem, "Della natura del cerchio e del operazione del compasso," Biblioteca Communale, Siena, Ms. L.iv.5; idem, "Esposizione del Sesto Libro di Euclide," Biblioteca Communale, Siena, Ms. L.vi.34. According to his biographers, he also wrote a treatise on the ellipse, but this text seems to be missing.

[61] Teofilo Gallaccini, "Della natura e forza del'acqua corrente, cadente, agitata, spinta e ritenuta; e di fiumi del territorio senese e delle fonti della città, e del mandare colonie," Biblioteca Communale, Siena, Ms. L.vi.32; idem, "Dei Porti di mare," Biblioteca Communale, Siena, Ms. L.iv.3. This treatise has recently been published. See Simoncini, ed., *Sopra i porti di mare.* According to Gallaccini's introduction, this work (conceived in the years prior to his return to Siena) was meant to obtain for him patronage from the duke of Naples; his plans apparently did not come to fruition.

[62] Teofilo Gallaccini, "Trattato di gnomonica," Biblioteca Communale, Siena, Ms. L.vi.35; idem, "Della natura e della forza dell'Acqua corrente e dei fiumi dello Stato di Siena, e delle Fonti di Siena," Biblioteca Communale, Siena, Ms. L.vi.32; idem, "Il Mondo celeste, overo trattato di cosmografia," Biblioteca Communale, Siena, Ms. L.vi.31; idem, "Dell lume, e della luce" and "Dello scintillar delle stelle" in "Varij e diversi discorsi Accademici, ed altre diverse compositioni fatte in molte occasioni di più tempi da Teofilo Gallaccini Medico, e Filosofo, e publico lettor di mattematica nello Studio di Siena, e fra gl'Accademici Filomati chiamato il Difettuoso," Biblioteca Communale, Siena, Ms. L.iv.1.

[63] Memmo, *Elementi,* 2.

[64] The only architect Lodoli names in this exalted group is Blondel. Ibid., 315.

[65] Ibid. The importance of Galileo for the development of engineering is confirmed by Parsons, who argues that before Galileo construction stresses were not understood to be subject to mathematical and physical laws. See William B. Parsons, *Engineers and Engineering in the Renaissance* (Baltimore, 1939), 482.

[66] On the shifts at the University of Siena as result of the reforms of 1589 and 1621, which placed the appointments entirely in the hands of the *principe* (who favored the University of Pisa and German and Jesuit scholars), see Ludovico Zdekauer, *Documenti per servire alla storia dello studio di Siena* (Siena, 1896).

[67] Targioni-Tozzetti quotes two passages from Gallaccini's "Mondo celeste, ovvero dell'Unità del Cielo" in which he describes the experiment (it took place in the month of August and was held in the Loggia Piccolomini in Siena) and his meeting with Galileo. Targioni-Tozzetti, *Notizie,* 318–319. For a real contrast to Gallaccini in terms of works and issues cited, see Mario Guiducci's *Discorso delle comete* (1619). Guiducci, *consolo* of the Accademia Fiorentina, to whose members he first presented his work, quotes Galileo and Tycho Brahe and overtly argues against Aristotle.

[68] See his list of sources in "Il Mondo celeste, overo trattato di cosmografia" (not paginated). Although Gallaccini wrote a commentary on one of Tartaglia's principal treatises, he does not mention his work on Jordanus, which did much to resurrect his ideas in the Renaissance. For the importance of Jordanus in the development of a new science of mechanics that unified statics and dynamics (and was achieved by Galileo), see Rose, *The Renaissance of Mathematics,* 82. For the importance of Benedetti in mathematizing physics and linking anti-Aristotelian views on mechanics to criticism of his cosmology, ibid.,154–156. See also *Cultura, scienze e tecniche nella Venezia del cinquecento. Atti del convegno internazionale di studio Giovan Battista Benedetti e il suo tempo,* ed. A. Manno (Venice, 1987).

[69] See Simoncini, *I porti di mare,* 5.

[70] The three comets that appeared in 1618 attracted the attention of all European scientists. In Florence Mario Guiducci wrote his *Discorso delle comete* (Florence, 1619) immediately upon the event. Gallaccini deals with the issue in his "Mondo celeste."

[71] For example, see Girolamo Borro, *De motu gravium et levium* (Florence, 1575); see also Filippo Fantoni, Galileo's predecessor at Pisa, who lectured on *de motu;* Francesco Piccolomini (Gallaccini's friend, and professor at the Collegio Romano), who included a section on *de motu* in his *Librorum ad scientiam natura attinentium* (1597). Benedetto Castelli (tutor to Matteo Barberini and professor at La Sapienza, also a supporter of Galileo) wrote *Della misura dell'acque correnti* (1628), recognized as the foundation of modern hydraulics, where he attends to "moventi e machine spiritali"; see also Luca Valerio's work *(De centro gravitatis),* which earned him the title of "Archimede della sua età"; he taught at the University of Rome from 1591–1618. For the curriculum at the Collegio Romano, see R. G. Villoslada, *Storia del Collegio Romano da suo inizio (1551) alla sua soppressione della Compagnia di Gesù (1773)* (Rome, 1954); for the curriculum at Pisa, see Schmitt, "The Faculty of Arts at Pisa"; for the University of Rome, see Filippo Maria Renazzi, *Storia dell'Università degli Studj di Roma,* 4 vols. (Rome, 1805).

[72] It would seem that Lodoli had produced a series of tables on what we call today the resistance of materials. These were based on experiments he had performed on effects of weights on different materials (wood, stone, marble, brick, etc.). Memmo, *Elementi,* 315. In the synopsis of the work Lodoli had intended to write (published by Kaufmann), it is clear that he placed great emphasis on these issues as well as on the joining of structural members. See Kaufmann, "Lodoli," 164.

[73] I am greatful to Christy Anderson for alerting me to this passage in Galileo's *Dialogues.* Poleni, *La cupola,* 32–34, 310–311.

[74] Barbaro, Bartoli, and Danti are known to have dabbled in building, whether as patrons (Barbaro) or as architects. Bernardino Baldi, *De verborum Vitruvianorum significatione* (Augsburg, 1612); idem, *Scamili impares Vitruviani* (Augsburg, 1612). For Baldi's mathematical activities, see Rose, *The Renaissance of Mathematics,* 243–279. Cosimo Bartoli, *Leon Battista Alberti. "De re aedificatoria"* (Venice, 1565; 1st ed., 1550); idem, *Del modo di misurare le distantie, le superfici, i corpi, le pinate . . .* (Venice, 1564). For Bartoli's architectural activities, see Charles Davis, "Cosimo Bartoli and the Portal of St. Appolonia by Michelangelo," *Mitteilungen des Kunsthistorischen Instituts Florenz* 19 (1975), 263–276. On Bartoli's engineering interests, see Daniela Lamberini, "La fortuna delle machine senesi nel Cinquecento," in *Prima di Leonardo. Cultura delle machine a Siena nel Rinascimento* (Milan, 1991), 135–146; and Alina Payne, "Architects and Academies: Architectural Theories of *Imitatio* and the Literary Debates on Language and Style," in *Architecture and Language,* ed. G. Clarke and P. Crossley (New York and London). For Ignazio Danti, see Giuseppe Baccini, "Un opera inedita del P. Ignatio Danti da Perugia, Vescovo di Alatri," *Archivio Storico per le Marche e l'Umbria* 4 (1888), 82–112; Thomas B. Settle, "Egnazio Danti and Mathematical Education in Late Sixteenth-century Florence," in *New Perspectives on Renaissance Thought,* ed. J. Henry and S. Hutton (London, 1990), 24–37.

[75] On this issue, see Payne, *The Architectural Treatise,* chap.1.

[76] Gallaccini's humanist interest included history, epigraphy, antiquarianism, and linguistics. For Gallaccini's literary work, see: "Informazione dell'antichità di Siena per Teofilo Gallaccini" (f. 83r–103v) and "Memoriale di cose antiche di Siena," Biblioteca Communale, Siena, Ms. A.viii.56; see also Biblioteca Moreniana, Ms. #53, "Discorso sull'antichità della Città di Siena composta dal celebre Teofilo Gallaccini e ritrovato tra le lui numartose opere manoscritte," and Ms. #14, "Memorie di cose di Siena. Discorso di Teofilo Gallaccini raccogliatore delle presente memorie," in "Varij e diversi discorsi Accademici," *discorsi* on Petrarch's *Trionfi* and on Plato; on *imprese;* on epigrams of Martial; "Sopra'l discorso di Bernardo Segni in Demetrio Falero nell libro della locutione"; "De amoris natura." Pecci lists another work that has not surfaced as yet: "I sinonimi della lingua Toscana" (1629).

[77] For a splendid account of this phenomenon, which extended beyond the literary and visual arts and included the sciences, see Rose, *The Italian Renaissance of Mathematics.*

[78] Amedeo Quondam, "La scienza e l'accademia," in *Università, accademie e società scientifiche in Italia e in Germania dal cinquecento al settecento,* ed. L. Boehm and E. Riondati (Bologna, 1981), 21–68.

[79] See, for example, the oeuvre of Francesco di Giorgio, Taccola, et al., all following in the footsteps of Vitruvius who included engineering sciences in his treatise on architecture. The issue has drawn a substantial scholarly activity. On the continuous relevance of these issues (particularly of geometry) through the Middle Ages into the Renaissance, see especially James Ackerman, " 'Ars sine scientia nihil est.' Gothic Theory of Architecture at the Cathedral of Milan," *Art Bulletin* 30 (1949), 84–111. A comprehensive discussion of the phenomenon of the arts turning to the sciences is offered by Martin Kemp, *The Science of Art* (New Haven and London, 1990).

[80] In his *Le scienze mathematiche ridotte in tavole* (Bologna, 1577), which amounts to a map of universal knowledge, Ignazio Danti includes architecture among the "scienze subalterne & mechanicae" alongside "numerare, cantare, machine, strumenti, misurare" but also alongside painting and sculpture. Several decades later Scamozzi is far more specific in singling out architecture: for him painting and sculpture belong to the literary and historical arts, whereas architecture belongs to rhetoric and especially to science. "Mà si [the architect] potrebbe più tosto paragonare al *Mathematico,* & *al Filosofo* naturale quanto alla speculatione, & alle forme, e quanto poi all'universale dell'altre parti *all'Oratore* essendo, che l'uno, e l'altro convengono havere cognitione di tutte le forme, e nature delle cose . . ." (emphasis added). Vincenzo Scamozzi, *L'idea dell'architettura universale* (Venice, 1615), I, 43. On Scamozzi's efforts to identify architecture with science, see especially Payne, *The Architectural Treatise,* 219–224.

[81] Fioravanti, a doctor and surgeon, includes architecture in his *specchio* of universal knowledge alongside "arte del speciale, aromatario, navigare, caccia, pescare, alchimia, cosmografia, anatomia," etc. His emphasis is on "isperienza," on practice, on "vedere in fatto" rather than "in disegno," and he is particularly eloquent when he comes to discuss the value of the *semplicisti* vis-à-vis doctors and of actual traveling for a cosmographer, and when he assigns more value to anatomy for artists than for doctors, who have to heal rather than know how parts look. One can conclude that his interest in architecture stems from this empirical-scientific bias toward the practical. Possevino seems to perceive a similar disjunction among the arts. In his *Ratio studiorum* he locates architecture with mathematics, geography, cosmography, and instrument making (Book XV) and places poetry with painting (Book XVII). See *Antonio Posevini Societatis Iesu Bibliotheca selecta dua agitur De Ratione Studiorum* (Rome, 1593). Scamozzi may well have been influenced by him for his own taxonomy of disciplines. See above, n. 80.

[82] On the Neapolitan architect Niccolò Antonio Stelliola and his appointment to the Lincei, see G. Gabrielli, *Atti dell Accademia dei Lincei. Carteggio Linceo,* 2 vols. (Rome, 1938–1939), 131, 198, 263–264. In his letter to Federico Cesi, the founder of the academy, Stelliola acknowledged the place conferred upon architecture in this exalted Linceian Pantheon: ". . . una tra l'altre speranze bone ch'io habbia, è che, dandosi nella nobile Accademia Lyncea luoco assegnato alla *scienza di Architettura,* siano col favor di essa Accademia per aprirsi le porte alla verità di questa arte . . ." Gabrielli describes Stelliola as "discepolo di Giordano Bruno, amico ed ammiratore del Campanella . . . un architetto poliedro, che aveva della sua arte e della sua scienza il concetto antico, vorrei dire etimologico relativo cioè alla costruzione, o 'tettonica' generale del mondo, della natura e dell'universo . . ." As member of the Lincei he corresponded with Galileo in particular on telescopes and lenses, a subject on which he too had published. See Niccolò Antonio Stelliola, *Il telescopio over ispecillo celeste* (Naples, 1627). The work was published posthumously by his son with financial support from Cardinal Barberini.

[83] Niccolò Stelliola, *Encyclopedia Pythagorea* (Naples, 1616).

[84] For example, the Sienese physician Benedetto Punta (a figure whom Gallaccini may well have known, given their shared interests) corresponded with the Neapolitan scientist Giambattista della Porta, one of the founders of the Lincei and the principal agent behind the election of Stelliola to the academy. Della Porta was also trying to get Punta elected to the academy. On this exchange of letters, see Gabrielli, *Carteggio Linceo* (letters 239, 263).

[85] Lorenzo Sirigatti, *La prattica della prospettiva* (Venice, 1596). Sirigatti has spectacular and very large plates of perspective constructions, but the steps that lead up to the complex images he illustrates are few and heavily dependent on Serlio's book on perspective. Nor are they a step-by-step didactic buildup from simple to complex through all the in-between stages, as are Gallaccini's.

[86] Very few Siennese syllabi from the seicento survive. Zdekauer knows only of twenty-eight, the oldest of which dates from 1654, that is, after Gallaccini's time. Ludovico Zdekauer, *Documenti,* 11. On the practice of writing out notes for lectures and their format when intended as such, see Charles B. Schmitt, "The Faculty of Arts at Pisa at the Time of Galileo," in *Studies in Renaissance Philosophy and Science* (London, 1981), 243–272.

[87] See Gallaccini, "Varij discorsi," from 1593 till 1603. The collection includes: "Dell lume, e della luce"; "Dello scintillar delle stelle"; "Se le città si devino fabbricare con le muragle overo senza"; "Delle meteore prodotte da vapori"; "Alcune oppositioni contro la definitione della sfera data da Teodosio nel libro delle sfere"; "Qual sia più sicura fortezza"; "Della nobilità dell'Architettura"; "Dell'arte in comparation à la Natura, e dell'imitatione dell'arte veso la quella"; "In quanti modi sia intesa l'Arte"; "Del Disegno."

[88] For analyses of this phenomenon in Florence, see especially Settle, "Egnazio Danti," and Mario Biagioli, *Galileo Courtier* (Chicago, 1993).

[89] Gino Folgari, "Il museo Settala. Contributo per la storia della cultura in Milano nel secolo XVIII," *Archivio storico lombardo* 14 (1900), 58–126.

[90] See Bacci, "L'elenco delle pitture" (see n. 35). It is uncertain whether Chigi was actually taught by Gallaccini (although it is very likely that he knew him at least, given his mention of Gallaccini's work); however, we do know that he was taught by his close friend Celso Cittadini.

[91] Connors, "Virtuoso Architecture," 24.

[92] On the issue of orality in Renaissance culture more generally, see Judith Bryce, "The Oral World of the Early Accademia Fiorentina," *Renaissance Studies* 9, 1 (1995), 77–103; and with respect to architecture, Payne, "Architects and Academies."

[93] Ostilio Ricci, "Problemi necessari per l'architettura militare & civile raccolti dal S. O. Ricci, mathematico et architetto del Sereniss. Gran Duca di Toscana" [c. 1600], Thomas Fisher Library, University of Toronto.

[94] Pietro Antonio Barca, *Avvertimenti e Regole circa l'architettura civile, scultura, pittura, prospettiva et architettura militare per offesa e difesa di fortezze* (Milan, 1620).

[95] Giovanni Branca, *Le machine* (Rome, 1629). On the frontispiece is a portrait of Vitruvius and Archimedes.

[96] ". . . questi che portaranno questo libretto in saccoccia, che ne sapranno molto più di noi." Giovanni Branca, *Manuale d'architettura breve, e risoluta pratica* (Ascoli, 1629), 113.

[97] Carlo Osio, *Architettura civile* (Milan, 1641). The book was reissued in 1661 and 1686.

[98] Alessandro Capra, *La nuova architettura familiare* (Bologna, 1678). Capra (1608–1683/5) worked for the Spanish governors of Milan, particularly on the restoration and reengineering of buildings, and on city fortification and defense. His publications included *Geometria familiare ed istruzione pratica* (1671), *Nuova architettura dell'agrimensura di terre* (1672), *La nuova architettura militare* (1683). He met and dealt with important geometers and specialists in fortifications (amongst them Barca), hydraulics, and "economia agricola." Most of his time was spent on his machine projects, especially those on irrigation. Bonacina (his biographer for the 1717 Cremona edition of the architecture treatise) described him as spending the last years of his life in his "casa-laboratorio, circondato dai modelli dei meccanismi da lui escorgitati." See Loredana Olivato, "Alessandro Capra," *Dizionario Biografico degli Italiani.*

[99] Costanzo Amichevoli, *Architettura militare* (Rome, 1684); idem, *Architettura civile ridotta a metodo facile, e breve* (Terni, 1675). Francesco Eschinardi, *Cursus physico-mathematicus* (Rome, 1689), dedicated to Francesco Redi; idem, *De impetu tractatus duplex* (Rome, 1684); idem, *Discorso . . . sopra la Cometa nuovamente apparsa* (Rome, 1681). It seems that he never built anything. For an account of his life, see M. Mucillo, "Costanzo Amichevoli," *Dizionario Biografico degli Italiani,* vol. 43, 273–274.

[100] See, for example, Antonio Lupicini, *Architettura militare con altri avvertimenti appartenenti a la guerra* (1582); *Discorsi sopra I ripari del Po* (1586); *Discorsi sopra I ripari delle inondazioni di Fiorenza* (1591).

[101] See, for example, Guarino Guarini, *Architettura civile* (Milan, 1968; 1st. ed., Turin, 1737); Bernardo Vittone, *Istruzioni elementari per indirizzio de' giovanni allo studio del Architettura civile . . . libri 3* (Lugano, 1760), and idem, *Istruzioni diverse concernenti l'ufficio del'Architetto civile . . . libri 2* (Lugano, 1766). On the

influence of the mathematicians Jacopo, Giordano, and Francesco Riccati (the "geometrica famiglia") on Francesco Maria Preti, see especially Ruggero Maschio, " 'Gli elementi di Architettura' di Francesco Maria Preti. Teoria e pratica costruttiva secondo 'una giusta ragione,' " in *Francesco Maria Preti architetto e teorico,* ed. L. Puppi (Castelfranco Veneto, 1990), 131–151, and Barbara Mazza, "L'ambiente culturale e artistico," in ibid., 51–77. On the issue of Guarini's modest mathematical contribution (if any) and lack of one in the area of analytical geometry, as well as on his use of very simple geometrical forms to achieve his vaulting, see Francesco Giacomo Tricomi, "Guarini matematico," in *Guarino Guarini e l'internazionalità del barocco, Atti del convengo 1968* (Turin, 1970), 551–557. Despite the *appearance* of scientific virtuosity, Guarini's architecture with its undulating walls and anthropomorphic connotations held fast to the *imitatio* mentality formulated in the Renaissance. On Guarini's geometry and his anthropomorphic *concetto,* see Henry Millon, "La geometria nel linguaggio architettonico del Guarini," in ibid., 35–60; and most recently Andrew Morrogh, "Guarini and the Pursuit of Originality: The Church for Lisbon and Related Projects," *JSAH* 57 (1998), 6–29. The only mention of Guarini that Lodoli makes is to his definition of architecture as "the faculty to order any type of edifice according to what Milliet taught in his course and in his *Mondo matematico,* vol. 1, 10th treatise, and nothing more." Memmo, *Elementi,* 281. The reference is to Claude-François Milliet Dechales (1621–1678), who had written treatises on Euclid and mathematics *(Huit livres des elements d'Euclide rendus plus facile).* Such a reference that ignores Guarini's architecture amounts to a *damnatio memoriae* on Lodoli's part.

[102] See n. 11.

[103] On the paradox between Aristotelian empirical observation and Platonic idealization of real conditions so as to construct a mathematical model of the universe, and on the importance of the latter for Galileo and modern science, see Westfall, *The Construction of Modern Science,* 21 (see n. 58). More specifically concerned with Galileo, see Alexandre Koyré, *Galileo Studies* (Atlantic Highlands, N.J., 1978).

[104] For the larger cultural context in which this fascination with the movement of machines was embedded, see Horst Bredekamp, *The Lure of Antiquity and the Cult of the Machine* (Princeton, 1995).

[105] Leon Battista Alberti, *On the Art of Building,* trans. J. Rykwert, N. Leach, and R. Tavernor (Cambridge, Mass., 1988), VI, 8. Daniella Lamberini notes the connection between bodies and machines in early instrument design in "Machines for Use on Building Sites," in *The Renaissance from Brunelleschi to Michelangelo,* exhibition catalogue, Palazzo Grassi, ed. H. Millon and V. Lampugnani (Milan, 1994), 478–480.

[106] On Puccini's illustrations, which include bizarre figures that seem to haunt the machines more than display their operations, see Daniela Lamberini, *Il principe difeso. Vita e opere di Bernardo Puccini* (Florence, 1990).

[107] This is particularly the case in his treatise "Porti di mare" (Ms. L.iv.3) where he illustrates his versions of Archimedean vises and caisson-driving instruments for underwater port construction/excavation, and in his treatise on Tartaglia where he illustrates measuring instruments. For his dependence on a long Sienese tradition of such designs that goes back to Taccola and Francesco di Giorgio, see Lamberini, "La fortuna delle macchine senesi"; for the Sienese tradition of instrument making, see Paolo Galuzzo, ed., *Gli ingegneri del rinascimento da Brunelleschi a Leonardo da Vinci,* exhibition catalogue, Palazzo Strozzi, Florence, June 1996–January 1997 (Florence, 1996), 117–186.

[108] Gallaccini, "Delle ragioni de tiri. Dell'artiglieria."

[109] On the *bottini* of Siena, see especially Galuzzo, *Gli ingegneri.*

[110] "... non e dubbio alcuno che questo [imitation of movement] si fa; posciache *questo si fa medianti il fondamento e principio naturale, che è il peso, quale per sua natura tende al centro, come naturale amante di quello;* onde sendo accomodato con le ruoti disposti secondo l'ordine, e modo, che vi si ricerca, movendosi quello inn giù fa che uno ruota e mossa dall'altra continuamente; per so che non è maraviglia del moto dell'orologij, e di alcune statue (hornamenti di giardini e fonti)" (emphasis added). Gallaccini, "Discorso dell'arte in comparation à la Natura, e dell'imitatione dell'arte veso quella," in "Discorsi academici," 65v. Indeed, he goes on to say that the alphabet imitates *(somiglia)* the movement of the lips—from observation the letters were designed for each idiom. Ibid., 66v. On the popularity of Hero and Pappus, see especially Rose, *The Renaissance of Mathematics.*

[111] In 1587 a new chair in anatomy was created at the University of Siena and Giulio Mancini was invited to hold it. He held the post till 1591 when the chair was given to Girolamo Minetti. G. Cascio Pratilli, *L'università e il principe. Gli studi di Siena e di Pisa tra Rinascimento e Controriforma* (Florence, 1975), 69–75.

[112] Tozzetti describes the treatise as "un laboriosissimo spoglio di autori antichi, non solamente anatomici, e medici, ma anche filosofi, e filologi, i passi dei quali concernenti la struttura, e gli usi diversi delle parti del corpo umano." Targioni-Tozzetti, *Notizie,* 318.

[113] Bacci, "L'elenco delle pitture di Fabio Chigi," 199.

[114] Since Mancini was practicing at the Ospedale Santo Spirito in Sassia in Rome, it may be supposed that Gallaccini (a physician himself) knew the hospital and the personalities associated with it through his friend and mentor. Ottaviano Mascherino was architect in charge of the palace and church at Santo Spirito at that time, and Michele Mercati, himself a Sienese, was *commandatore* of the hospital till 1593 and commissioned his friend Mascherino to work on the church and the palace. Among the first notices on Mascherino and notice of his connections with the hospital of Santo Spirito and position of *principe* at the Accademia di San Luca (to which he willed his corpus of drawings), see Giovanni Baglione, *Le vite de' pittori, scultori et architetti* (Bologna, 1975; 1st ed., 1649), 99–100. For Mascherino's work in Rome (the churches of San Salvatore in Lauro, Santa Maria in Traspontina, Santo Spirito in Sassia, etc.), see Raffaello Ojetti, "Ottaviano Mascherino," in *Annuario della R. Accademia di S. Luca MCMXII* (Rome, 1913), 1–15; Melchior Missirini, *Memorie per servire alla storia della Romana Accademia di S. Luca* (Rome, 1823), lists Mascherino as "professore accademico" of the Accademia di San Luca. Most recently see Jack Wasserman, *Ottaviano Mascarino and the Drawings in the Accademia Nationale di S. Luca* (Rome, 1966). On Michele Mercati's involvement with Santo Spirito, see Pietro Capparoni, *Profili bio-bibliografici di medici e naturalisti celebri italiani dal sec. XV al sec. XVIII* (Rome, 1925–1928), 54.

[115] See especially Gallaccini's *discorso* on "disegno interno, esterno e del mezzo" in "Discorsi academici."

[116] For example, see (posthumously published) Michele Mercati, *Metallotheca* (Rome, 1717); and idem, *De gli obelischi di Roma* (Rome, 1589). Not only does Mercati publish a work on the obelisks but his magnum opus, the *Metallotheca* (which counts as a founding work for mineralogy), contained much on the arts and antiquities (under the *Armarium X* he deals with marble and discusses ancient sculpture and illustrates ancient marbles in the Vatican collection). On Mercati's life (1541–1593), see Capparoni, *Profili bio-bibliografici di medici,* 53–56.

[117] David Freedberg, "Iconography between the History of Art and the History of Science: Art, Science, and the Case of the Urban Bee," in *Picturing Science Producing Art,* ed. C. A. Cones and P. Galison (New York and London, 1998), 272–296.

[118] Gallaccini, "Del disegno," in "Discorsi," 39v–41r.

[119] On this issue, see especially James Ackerman, "Early Renaissance Naturalism and Scientific Illustration," in James Ackerman, *Distance Points* (Cambridge, Mass., 1991), 185–207.

[120] "Ciascun *congiugnimento* è posto al suo debito luogo, ed è di figura tale, che *rende stabile,* e determinato e differente moto ciascun membro, poi che qualunque particolar *commessura* è dotata di quantità, di numero, e di figura solamente disposta *a formar nel suo proprio membro il suo moto naturale* . . ." (emphasis added). And he continues: "Dunque dall'osservatione di questa machina mondiale, e di questo miocrocosmo ha potuto l'humano ingegno ritrar l'architettura la quale con debite misure, e proporzioni, e con ornata e bella dispositione di figure corporee ogni maniera di edificio, che à l'uso humano si richiede." Gallaccini, "Della nobilità dell'Architettura," in "Discorsi," 68v–69v.

[121] When he criticizes the treatment of stone as if wood or stucco he argues that when used properly "la pietra ha legamento reale col tutto, nascono insieme con esso." And he continues on the subject of *rompimenti:* ". . . si rompe la continuazione degli ornamenti, si disunisce il compartimento e si scioglie il legame delle parti fra loro, e col tutto." Gallaccini, *Errori,* 45. In his treatise on perspective he defines architraves as working "per aiutare a reggere il peso delle colonne e per *congiugnimento* d'esse e per *congiugnere* tutta la macchina insieme" (emphasis added). Idem, "Prospettiva."

[122] See n. 73.

[123] This direction for a discourse on movement, which crosses from astronomy to mechanics to natural science and anatomy, is already evident in the work of Benedetto Castelli (another supporter of Galileo's and professor at La Sapienza), who also attempted in his *Mattonata* to develop a "scienza del moto"

(science of movement) that connected the movement of stars, animals, and machines.

[124] On the awkwardness of scientific discourse that was mired in verbal description and lacked the eloquence to convince in the prealgebra period, see Francesco Giacomo Tricomi, "Guarini matematico," in *Guarino Guarini e l'internazionalità del barocco. Atti del convengo 1968* (Turin, 1970), 551–557.

[125] See Lorraine Datson and Katherine Park, *Wonders and the Order of Nature 1150–1750* (New York, 1998).

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