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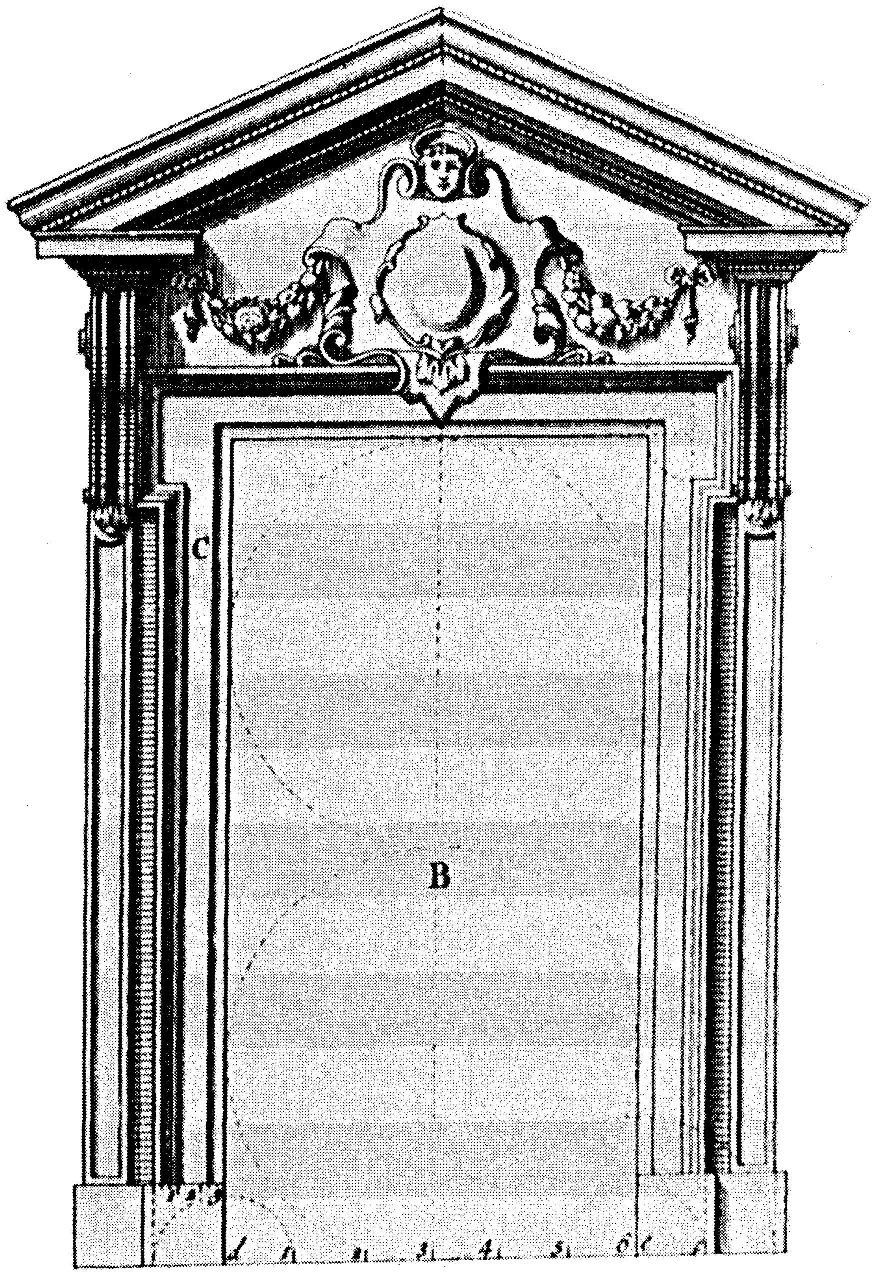
GEOMETRICAL OPERATIONS AS A SOURCE OF MEANING



The great role mathematics played in seventeenth-century European architecture has already been hinted at in relation to the theory of François Blondel, Perrault's traditional opponent. The most explicit assimilation of the new geometrical universe by architecture appears in the work of Guarino Guarini, whose fascinating buildings in Turin and the Piedmont unquestionably represent a high point in Baroque architecture. Guarini, a Catholic priest, synthesized the scientific, philosophical, artistic, and religious interests of the day in his architectural theory and practice.

The literary and architectural production of Guarini is prodigious. His writings encompassed the theatre, philosophy, Euclid's *Elements*, astronomy, topography and the mensuration of buildings, as well as an important architectural treatise that appeared posthumously in 1737.[1] Although it is probably fair to say that Guarini was not an original thinker, his understanding of modern philosophy was thorough.

Guarini lived in Paris from 1662 to 1666, where he taught theology and published his philosophical treatise, *Placita Philosophica*. This work explained the crucial relation between the Cartesian *res cogitans* and *res extensa* in the occasionalistic sense: The only real and effective cause is God; finite beings are only the natural and occasional causes for the realization of Divine Will. In two works, *De la Recherche de la Vérité* and *Entretiens sur la Métaphysique* (published after Guarini's *Placita*), the French philosopher Nicolas Malebranche postulated the reconciliation between the human mind and the external world through God; every idea is "in God," and only in Him can the human mind comprehend His work. Malebranche believed that man did not perceive the specificity of things, but rather saw transparent and pristine ideas that were necessarily always in God. Guarini used a similar argument: Our knowledge of things is fulfilled through our apprehension of ideas in God; the ideas thought by man are the same divine ideas, or the archetypes that are contained in the Verb and have been communicated to us only in an imperfect way. For both Guarini and Malebranche, faith was synonymous with mathematical knowledge, and the *mathesis* implicit in all finite beings was equivalent to their immanence in God.[2]

In the *Placita*, Guarini stressed that mathematics constituted the foundation of human reason and that a mathematical knowledge of nature was equal to divine knowledge. But he also believed that spiritual things were ineluctably evident to our senses, so that mathematical rationality never contradicted sensuous experience as a source of knowledge. There was no dilemma because ultimately all knowledge was resolved in God. Thoughts were not real things, however; an authentic science of real essences was reserved for God. Intellectual problems for Guarini thus became a synthesis of reason and sensuous experience; only such a synthesis could effect true transcendental knowledge.

Guarini recognized the limitations of ancient philosophy vis-à-vis modern science. In his opinion, only moderate respect was due to the traditional texts. He openly embraced the geometrization of the universe brought about by the Galilean revolution and adopted the modern belief in the possibilities of mathematical reason and experimental knowledge. It is significant and typically Baroque that having taken this position, Guarini was also able to reject the heliocentric system of Galileo. He perceived no contradictions in this attitude, which also allowed him to accept elements of the traditional Aristotelian cosmology, which were, in fact, more in line with his religious faith. Indeed, the Holy Scriptures were the ultimate frame of reference for Guarini's scientific theories.

Guarini's cosmological system is interesting because it clearly shows the Baroque obsession to synthesize the specificity of perceived phenomena with a geometrical theory. Pre-Copernican astronomy concerned itself with the geometrical nature of planetary orbits; Aristotelian cosmology attributed a geometrical and mathematical regularity to the celestial spheres. The heavens were believed to be immutable, and therefore irregularities were never observed. Guarini rejected Galileo's system as just one more geometrical hypothesis of the traditional kind, unable to explain our actual experience of the universe. His own theory was designed to reconcile the physical, observed nature of the planetary orbits with the immobility of the earth, still perceived as the center of the cosmos. This theory, believed to save all phenomena was, nevertheless, geometrical and based on a geocentric system, with the sun and the planets revolving in sinusoidal orbits around the earth.[3]

Geómetry, for Guarini, was not only one science among others; it was the prototypical Universal Science, comprising all dimensions of human thought and action, capable of reaching the truth through intellectual argumentation based on precise relations and combinations.[4] Absolute truth was derived from mathematics, the science that drew its conclusions directly from first principles.[5] Malebranche would add that the universal science of geometry could also open the human intellect, increase its capacity of attention and guide its imagination.[6]

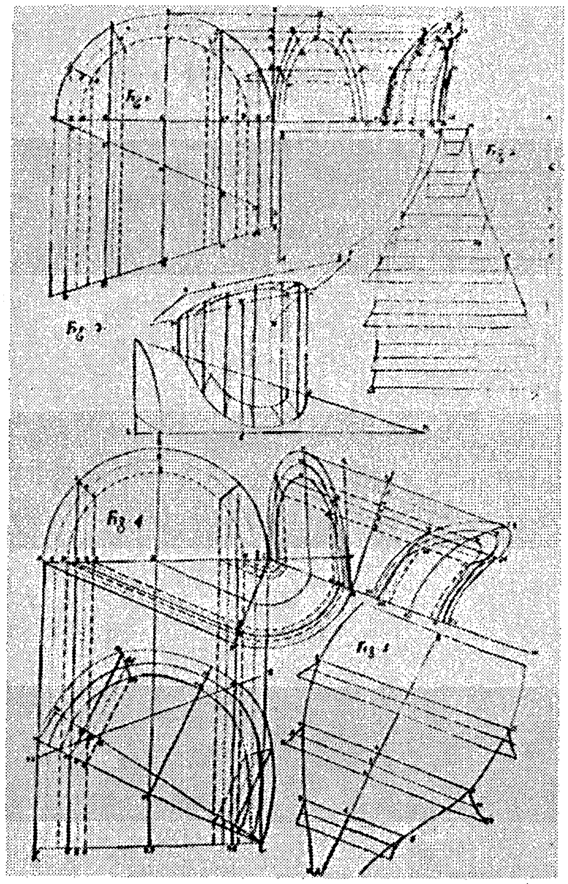
Guarini's geometry had all the implications of an *ars combinatoria*, the traditional science of permutations that was accepted during the Middle Ages and the Renaissance as a true mirror of perceptual reality. These logical systems were believed to possess a magical transcendental dimension, endorsed by God or His agents. Generally, this was still the logic of seventeenth-century metaphysical systems.[7] All that any human could aspire to was a knowledge of relations; thus the geometrization of knowledge was perceived as an urgent task. In Guarini's work, philosophy, astronomy, physics, theology, architecture, engineering, and poetry all converged in geometry.[8] Geometry symbolized the highest values, but it was not opposed to nature. It possessed simultaneously celestial and terrestrial connotations; it was both the science of the stars and topography. Geometrical form guaranteed the truth of theory, while geometrical operations were used as a tool for the transformation of the world, reinforcing the traditional meaning of practice.

Guarini's treatise, entitled simply *Architettura Civile*, represents the first attempt to postulate a theory of architecture subject totally to the laws of geometry and mathematics. There were some precedents to his mathematization of architectural theory, but these were understood as part of the wider context of intellectual disciplines. Guarini himself cited as an important source C. F. Milliet Dechales's *Cursus seu Mundus Mathematicus* (1674), an immense compendium of knowledge *more geometrico* that included architecture. In his *Architettura Civile*, however, Guarini not only asserted that "architecture depends upon mathematics and geometry" but also emphasized that it was a "flattering art" that should never disgust the senses in order to please reason.[9] Thus Guarini defines the essence of architecture to be the synthesis of mathematical reason and sensuous qualities. Architecture depended on rules derived from mathematical reason *and* empirical experience, with no possible contradiction between the two. Moreover, Guarini thought that both the structural safety of buildings and their beauty and proportion, being the most important objectives of architecture, derived from the same rules.

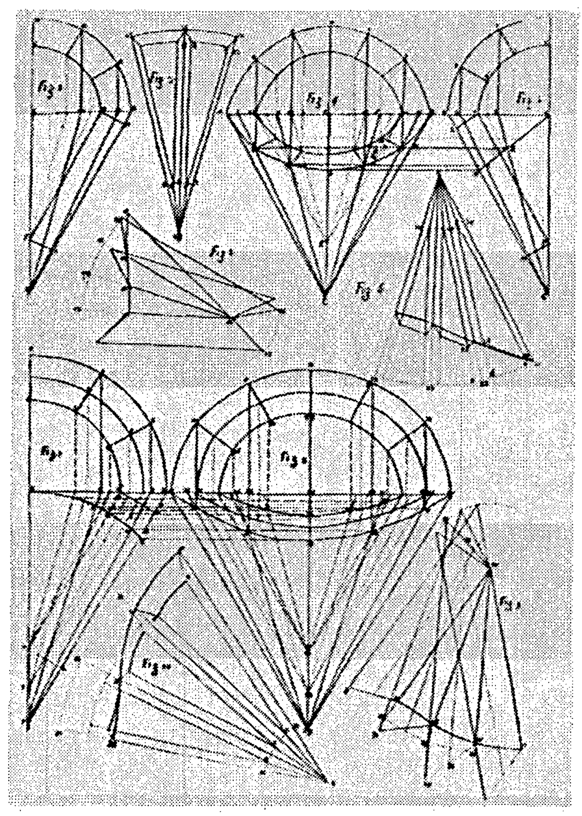
Guarini accepted the possibility of correcting and modifying the architectural rules of antiquity and perceived the discrepancies that existed between Vitruvius's theory and many important buildings of the past. In accordance with the new epistemology, Guarini preferred mathematical reason and empirical observation to ancient authority. Nonetheless, his deep roots in a traditional cosmology kept him away from any relativism. For Guarini, absolute rules constituted a fundamental point of departure in architecture.

Like François Blondel, Guarini believed that optical corrections were necessary to compensate for the distortions caused by perspective; and believing that a primary aim of architecture was to please and seduce our senses, he further developed the rules for optical correction. Nevertheless, he cautioned that architecture should never go to the extremes of perspective illusionism. A delicate balance had to be maintained since perspective was concerned only with delight and disregarded the structural stability and solidity of buildings. Guarini thought that architecture to be truly pleasant must possess a "real symmetry" that did not attempt to fool our sight.[10] Architecture had to be governed by a rational geometry capable of providing stability to the building, but also a geometry whose combinations and figural transformations could generate symbolic form and space. In this way, the ultimate meaning and beauty of architecture depended on the implementation of geometrical operations.

A major part of *Architettura Civile* was devoted to the description of geometrical combinations and manipulations, applied to all aspects of design and construction. The principles of geometry provided by Guarini were strictly Euclidean.[11] Guarini did not use the incipient projective geometry recently discovered by his contemporary Girard Desargues, of whom more will be said later. The postulate of the nonconvergence of parallel lines was defended by Guarini in the *Architettura*, where he emphasized the importance of intuition in a thoroughly Aristotelian vein. His geometry was never an abstract mathematical discipline, but depended on an intimate relation with the figures (the square, the triangle, the pentagon, and so forth) as perceived initially by our senses. In this respect, Guarini's edition of Euclid's *Elements* is significant. Although this was a treatise on geometrical theory, every single operation, including the most simple arithmetical ones, was presented graphically. Algebra was conspicuously absent. The specific image of each problem was obviously considered essential, making Guarini's geometry not only visible but also tangible, a true science of the real world. Only such a conception of geometry could lead him to assert that "the miraculous creativity of distinguished mathematicians shines intensely through regal architecture."[12]



Stereotomic tracings, from Guarini's *Architettura Civile*.



In his *Architettura Civile,* Guarini established a strictly geometrical method for determining the proportions of the classical orders, avoiding numerical relations. He cited as his source the work of a rather unknown figure, Carlo Cesare Osio, who had published his own *Architettura Civile* in 1684.[13] Osio's treatise was devoted entirely to the teaching or application of geometry as an instrument in drawing the five classical orders. After showing how to divide a straight line into a given proportion with the use of the compass, Osio provided detailed instructions for the design of any classical element by means of that simple operation. Although Osio apparently believed in the importance of proportions, it is significant that he never mentioned the great authors of antiquity and disregarded the issue of which were actually the most correct dimensions. Osio declared that his sole aim was to put forward a simple method that would facilitate architectural practice.

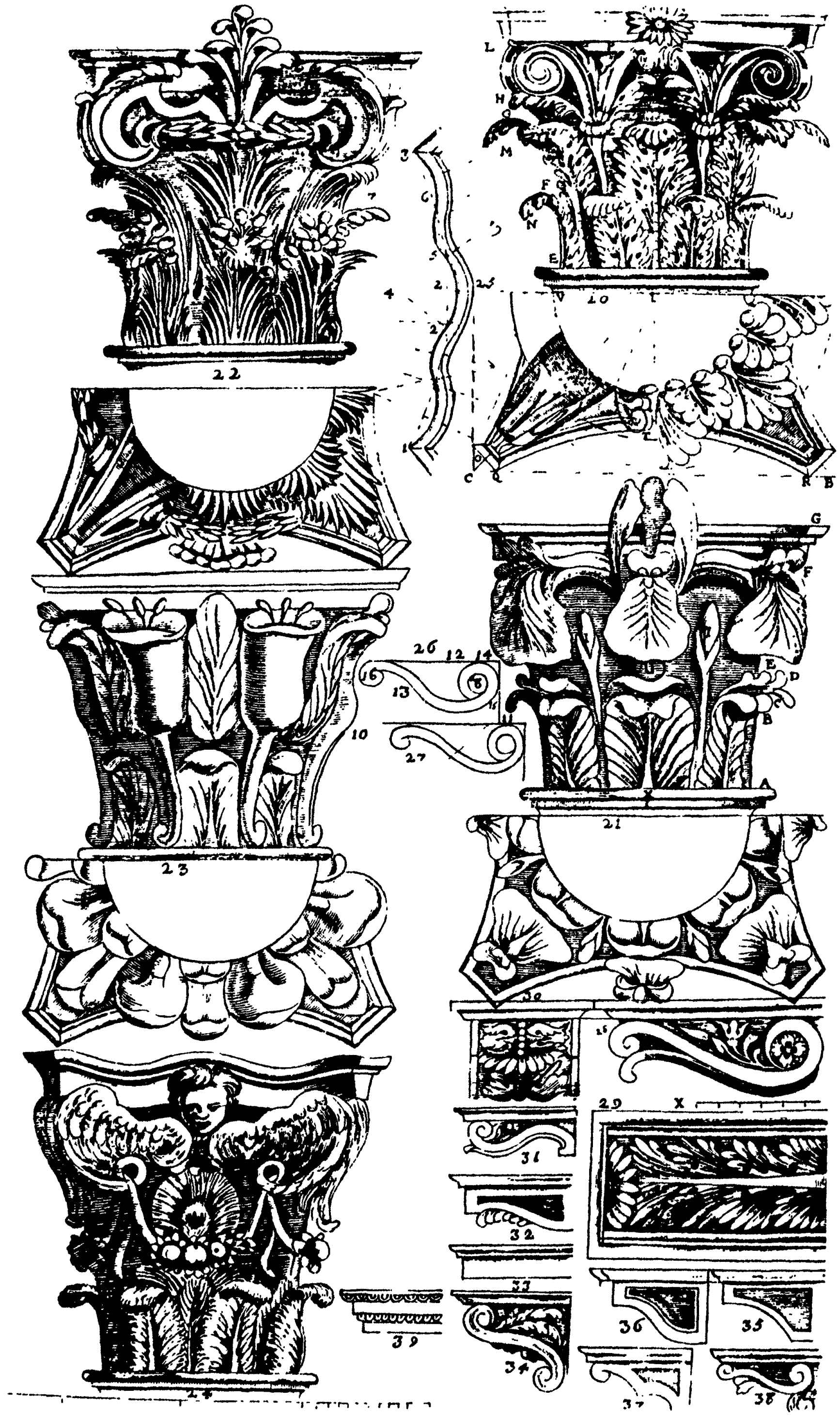
The traditional concerns of architectural theory, although ambiguous, were more explicit in Guarini's text. The section on the orders was introduced by showing how to trace some "necessary" curves, such as the spiral and the sinusoid. But then Guarini reproduced Vitruvius's story about the origin of classical forms and their proportions, "derived from the human stature."[14] Compared to previous treatises, the issue of the classical orders was given much less importance by Guarini, who subordinated everything to geometry. And although he believed that beauty depended on proportion, he was skeptical about the possibility of finding what actually caused pleasure in a well-proportioned and symmetrical elevation. He implied that there was an invisible cause, but obviously distrusted number. He defined proportion as a just correspondence between the parts and the whole; but rather than implying a perfect Renaissance fit, his intention was only to avoid excessively large or small pieces. After providing some general rules for the disposition of the orders and pointing out how different authors had divided the module into diverse units, he proposed to divide it into twelve parts for purely practical reasons.

Guarini was aware of the conflicting opinions regarding the orders and their proportions. Although he pretended to respect the authority of certain prestigious authors, quoting them as sources for his own recommended proportions, his own three orders are highly original inventions. Their ornamental detail, which is more exaggerated and conspicuously less abstract and geometrical than that of his sources, attempts to realize the complexities of natural (particularly vegetable) shapes. These plates appear striking, placed as they are between stereotomic projections and manifold geometrical applications. The fundamental coherence of Guarini's theory, impossible to appreciate adequately through the contrast of his rhetorical naturalistic ornamentation and his concern for precise geometrical methods, becomes explicit once the symbolic sense of his geometrization of architecture is fully comprehended.

Technical problems were extensively discussed in *Architettura Civile*. Guarini described methods for leveling and topographic surveying in which buildings were treated as additions of geometrical elements; walls, domes, and columns were actually addressed as geometrical bodies. A similar transformation is evident in a little book that Guarini wrote specifically on the problem of measurement in buildings. His *Modo di Misurare le Fabriche* was conceived as the practical application of the principles he had developed in his *Euclides*. In it he provided methods for measuring and determining the cubic volumes of any part of a building, even of those elements that were hardly regular. However, there is no allusion to any real problems of building; after a brief introduction to mathematics, Guarini merely explained how to measure areas and regular volumes.

After discussing the geometrical nature of vaults, Guarini devoted a whole section of his *Architettura* to stereotomy. The use of geometrical projections to determine the shapes and proportional dimensions of wooden or stone elements of domes, arches, vaults, and stairs had been first introduced into architectural theory by Philibert de l'Orme during the sixteenth century. Guarini emphasized the importance of stereotomic tracings, whose complexity led Rudolph Wittkower to underline the "mechanical" dimension of his architecture. It is clear, however, that Guarini's plans never required any sort of projective geometry to be realized in three dimensions.[15] His stereotomy never implemented the discovery of Girard Desargues, as some scholars have imagined;[16] the significance of this will become clearer from the perspective of later chapters. Guarini's geometry was not a descriptive geometry; every problem generated its own method, as was the case in the traditional treatises of Derand and De l'Orme.[17]

Unlike previous Renaissance treatises, Guarini's subjected all the technical operations of architecture to geometry. This modern attitude, nevertheless, has to be carefully qualified; its meaning can only be understood in relation to the crucial role that geometry



Details of composite capitals, from Guarini's *Architettura Civile.*

played in the totality of his work. Architecture for Guarini combined the objectives of seventeenth-century science and philosophy. His architectural intentions were totally coherent, without conflict or distance between his artistic and scientific interests.

Geometry was used by Guarini as a precise technical tool; it was an instrument, a set of operations, but always implemented to achieve a reconciliation between spiritual values and the world of man. The basic geometrical figures of Euclidean science became the elements of an *ars combinatoria* in which the figures were combined and transformed to design extremely complex and seductive buildings. Created with the most simple elements, a Guarini church becomes a true microcosm, capable of reflecting the order of an Aristotelian world through the qualities of natural perception and the persuasive use of light and textures.

It has been pointed out that Guarini's churches were conceived as monumental models that reproduced the structural system of the universe, registering the influence of the planets, the phases of the moon, and the harmonic motion of the heavenly spheres.[18] His architecture, however, was not merely a reflection of the geometrical structure of the cosmos, but achieved the status of quasi-natural objects, created through the magic of combinations and an emphasis on the sensuous qualities of matter, a process that Guarini considered analogous to that of divine creation. Thus geometry was deemed capable by Guarini of reconciling Platonic symbolism with the Aristotelian world of everyday life and traditional religion.

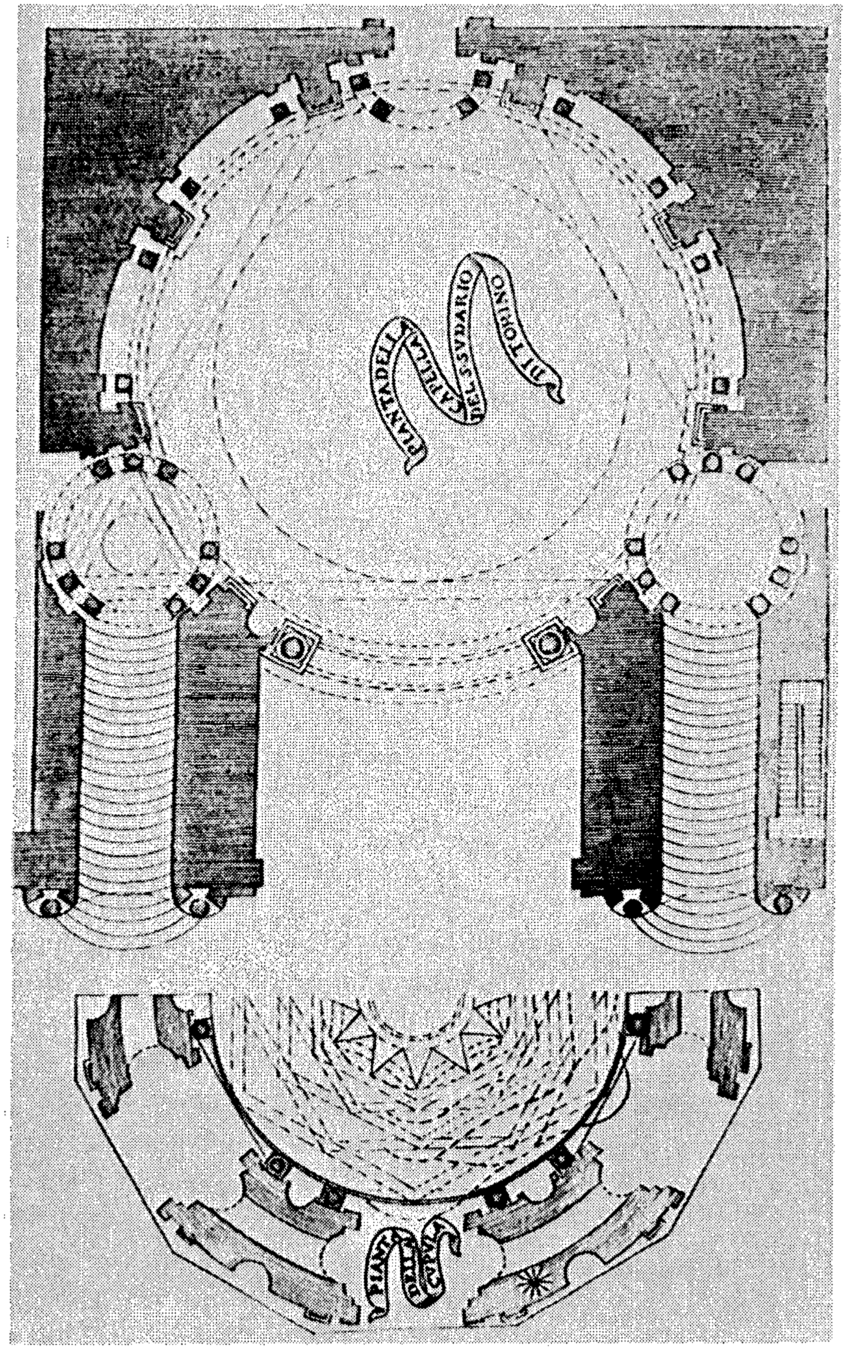
In Guarini's work, the formal and transcendental dimensions of geometry were perfectly reconciled. The geometrization of the world had been the result of the Galilean revolution; geometrical science became a prototype of true knowledge. But Guarini's Baroque geometry was not merely a formal science; it was an instrument of rhetoric as well as logic. In keeping with traditional, Aristotelian perception, geometrical figures assumed the character of symbolic essences, always derived from sensuous intuitions. The geometrization of *res extensa* was the point of departure of modern science and technology, allowing for an increasing exploitation and desecration of nature. During the seventeenth century, however, the geometrical structure of the cosmos guaranteed the perception of absolute values, establishing an immediate relation between *res cogitans*, *res extensa*, and God.

Baroque architecture emphatically utilized geometrical operations to determine forms and spaces. Geometry replaced the authority of the ancients as the source of ultimate justifications in architecture; it became, in fact, a metaphysic, transforming the world of man into a symbolic universe. Architectural historians have commonly regarded the technical dimension of these geometrical operations as a curious but mistaken precedent for statics and structural mechanics. Thinking in terms of formal styles, they have been unable to recognize the fundamental continuity between intentions that resulted in the sensuous ornamentation and spatial complexity of some buildings and intentions that motivated austere and dominating schemes such as Versailles or the geometrical transformation of cities. Only by accepting the essential symbolic dimension of geometrical operations in architecture within the epistemological framework of the seventeenth century is it possible to discern the coherence of Baroque architectural intentions, containing both rational and sensuous dimensions.

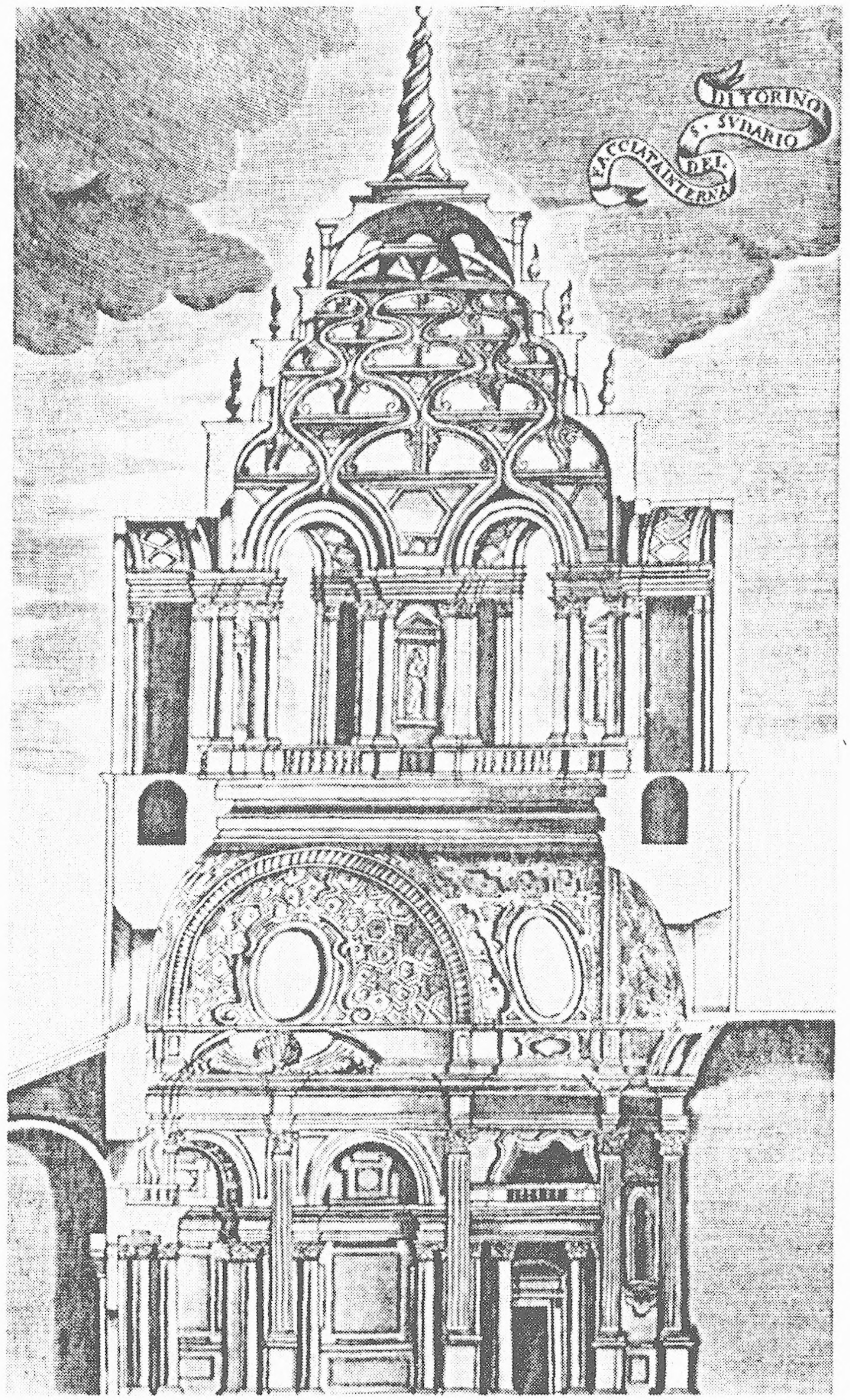
Desargues's Universal Method and Perspective

Any study on the impact of modern science upon the architecture of the seventeenth century would be remiss if it failed to examine the work and ideas of Girard Desargues (1593–1662). Desargues was an architect and engineer, and probably the most brilliant geometrician of the seventeenth century. Many of his works were published around 1650 by his disciple Abraham Bosse, including two treatises in which he proposed a universal method (*manière universelle*) for solving problems of perspective on flat and irregular surfaces and a book on stereotomic projections for stonecutting.[19] His complete works, however, including an important piece on pure geometry, were not published until 1864.

Desargues sought to establish a general geometric science, one that might *effectively* become the basis for such diverse technical operations as perspective, stone- and woodcutting for construction, and the design of solar clocks. These disciplines had always had their own theories, which ultimately referred to the specificity of the techniques themselves. Desargues's interest was exceptional even in the context of the seventeenth century. In order to find universal geometrical principles that would allow him to structure a common theory for the operations of the techniques in question, Desargues disregarded the transcendental dimension of geometry and the symbolic power of geometrical operations. In practical terms, he had to discover the theoretical properties of geometrical perspective (*perspectiva artificialis*). Having identified theory with an *ars fabricandi,* he aspired toward the rational control of practice,



Plan and section of Guarini's design for the Church of the Holy Shroud (S. Sudario) in Turin, showing the geometry of the dome, from *Architettura Civile*.


FACCIATA INTERNA DEL S. SVDARIO DI TORINO

not an explanation of its reasons.[20] Consequently, he could ignore the symbolic implications of infinity and was capable of introducing this notion into geometry for the first time in the history of Western thought.

Such an accomplishment is difficult to appreciate from a contemporary vantage point, which regards visual perspective as the only true means of comprehending the external world. In fact, preconceptual perception, evident in the art of children or primitive and non-Western cultures, is not a perspective perception. Parallel lines did not converge in Euclidean space, where tactile considerations, derived from bodily spatiality, are still more important than purely visual information.[21] Euclidean geometry was conceived as a science of immediacy[22] whose principles had their origin in perception. Like Aristotelian categories, its rules were a posteriori. In a real sense, Euclidean theory is almost a practice, with intuition at its roots. Euclid's theorems are exact and true only insofar as the things to which they make reference are accepted as variable and imprecise.

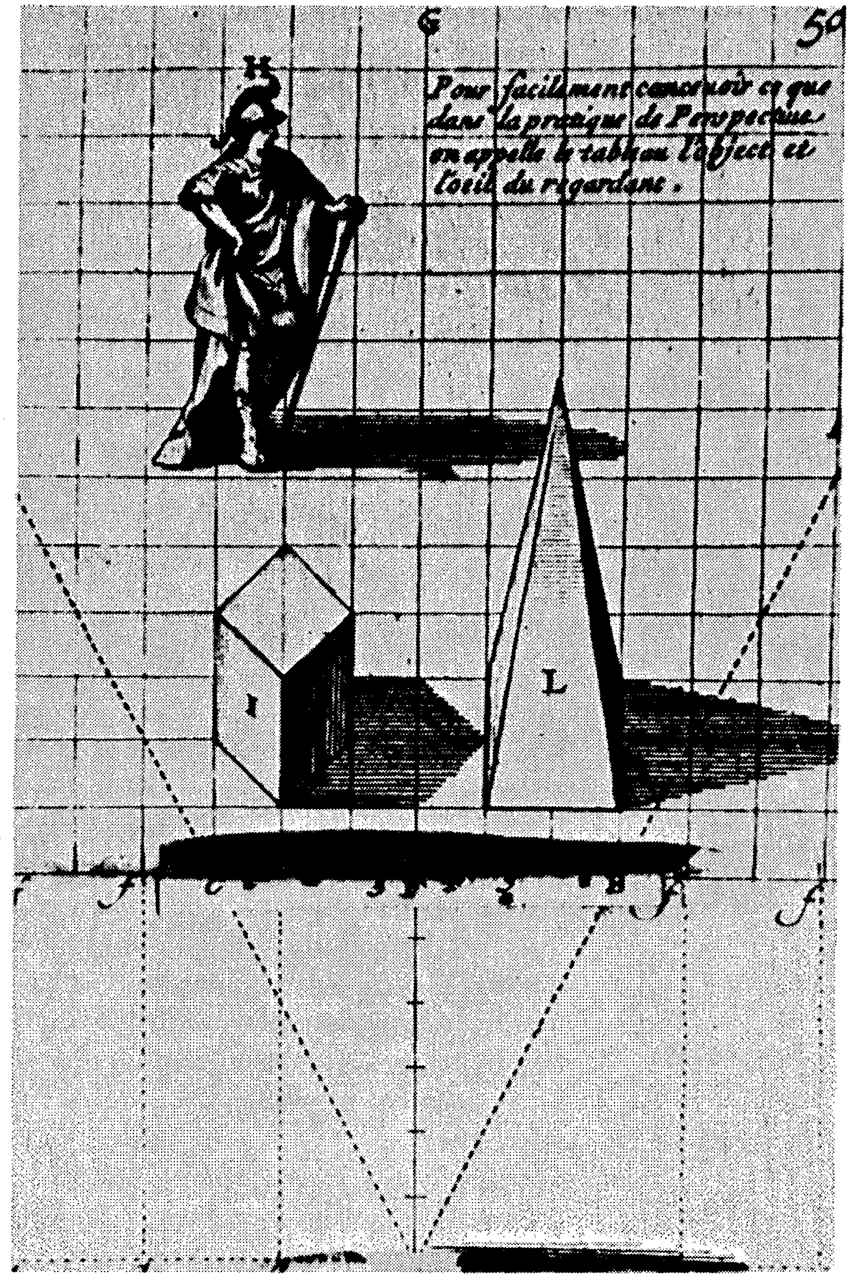
Desargues maintained, however, that all lines converged toward a point at infinity. Thus any system of parallel lines, or any specific geometrical figure, could be conceived as a variation of a single universal system of concurrent lines. Desargues's basic aims would eventually be fulfilled by Gaspard Monge's descriptive geometry toward the end of the eighteenth century. In fact, Desargues's fundamental principle, which stipulated the tracing of perspective projections without the use of arbitrary points of distance, would become the general postulate of projective geometry, a science that would be developed during the second decade of the nineteenth century by Jean-Victor Poncelet. The postulate read, "If placed two by two on three lines converging in one point, the prolongation of their sides will converge in three points of a single line."[23]

In his *Manière Universelle pour Pratiquer la Perspective*, Desargues emphasized that there was no difference between the drawing of a plan and that of a perspective, as long as an appropriate scale of real dimensions projected to infinity was used. A scale of this nature was to be employed for each one of the Cartesian axes in order to construct perspectives that avoided all empirical considerations. The traditional, more or less arbitrary, tracings were, in his opinion, irrelevant complications. Desargues's theory of perspective, in contrast to that of his contemporaries and successors, was precise and autonomous (independent of reality, that is). Thus it could become a general science of geometrical projections, capable of controlling and rationalizing the most important techniques of architecture. The laws of perspective became the first "theory of theory," truly independent of practice. The actual drawing and construction of perspectives, the design of solar clocks and the determination of the shape and dimensions of stone pieces for vaults and arches, all depended upon the same system of oblique projections and thus could be reduced to a methodology. For the first time, regardless of the architect's capacity to visualize the operations, true results were guaranteed by this formal logic, even arriving at "inferred" conclusions that might not be explicit in the "premises" of practice and embodied reality. Desargues *manière universelle* was in fact the first step toward a functionalization of reality that would precipitate the Industrial Revolution and the crisis of European science during the nineteenth century.

The significance of this remarkably early functionalization of three-dimensional reality should be emphasized. Once perspectivism was introduced as a condition of thought by Cartesian dualism, the theory of perspective could become the first autonomous general science. Desargues recognized the *continuity* that existed between the descriptive characteristics of geometrical figures and bodies. He was the first to discover that the conic sections (parabola, hyperbola, and ellipse) were only perspective projections of a circle. In the context of Euclidean geometry, such continuity was never recognized. For each qualitatively different figure, there was a corresponding interpretation and deduction; each geometrical problem was solved according to its specific character.

Functioning independently of reality, Desargues's theory avoided metaphysical concerns. His astounding protopositivism, which was closer to the architectural intentions of the nineteenth century than to those of the Enlightenment, was never accepted by his contemporaries. Artists and craftsmen tended to reject any reduction of theory to the condition of *ars fabricandi*. They continued to use empirical methods for the different techniques of architecture, methods by which practice and rules were closely related.

It is interesting to mention in this respect the problems that Bosse faced in the Royal Academy of Painting and Sculpture when he attempted to teach Desargues's *manière universelle* to



Desargues's simplified perspective method, from Bosse's *Manière Universelle pour Pratiquer la Perspective* (1648). Desargues's method avoided the use of vanishing points outside the picture plane.

art students. The main point of contention was the universal applicability of Desargues's theory, which was nothing less than an ontological attack against traditional practice. After a lengthy struggle, Bosse was dismissed. It was clear that Desargues's geometry was not the Euclidean science that allowed artists to fulfill their symbolic intentions. Desargues's work was indeed rejected, but it cannot be discounted. It reveals the full and immediate impact of the epistemological revolution, opening the way to an effective technological domination of reality. His intentionality, although explicit only in relation to certain techniques, was already that of modern architecture.

The noticeable return to the phenomena, implicit in the method of physics and natural history during the eighteenth century, reinforced the status of Euclidean spatiality. During the Enlightenment, Desargues's name was forgotten. The Italian geometrician G. Saccheri, editing and commenting Euclid's *Elements* in 1731, had in hand all the necessary technical knowledge to refute the axiom of the nonconvergence of parallel lines.[24] Had he obtained the conclusions that clearly lay in the path of his investigation, Saccheri might have hit upon non-Euclidean geometries a hundred years before their time. It is significant, however, that without any clear logical reason, the Italian geometrician never concluded his speculations. The true cause of this has eluded most historians of science, though it is probably nothing more than a question of true cultural limitations; Euclidean space, still the space of embodied perception, was the horizon of thought and action in the eighteenth century.

After Leibniz, the magical attributes of *ars combinatoria* were discredited and geometry and mathematics lost their symbolic dimension, maintaining only a formal value. This situation advanced the transformation of applied mathematics into a powerful instrument for the technological domination of reality. But this transformation, as I have already explained in the previous chapter, did not actually occur in the eighteenth century. From the point of view of a scientific teleology, the systematization of reality was absolutely imperative as a precondition of the Industrial Revolution and positivism. The process of geometrization that had been initiated by the epistemological revolution ceased during the eighteenth century, restrained by the renewed interest in empirical methods.

Once geometry lost its symbolic attributes in traditional philosophical speculation, perspective stopped being a preferred vehicle for the transformation of the world into a meaningful human order. Instead, it became a simple representation of reality, a sort of empirical verification of the way in which the external world is presented to human vision. The Enlightenment generally abandoned the use of perspectives that had been so crucial for Baroque architecture, urbanism, and gardening. Without its immanent symbolic sense, perspective became synonymous with an objective perception of external reality. This transformation was equivalent to a return to the more traditional empirical methods of perspective construction. Subsequently, the artists and writers interested in the subject during the Enlightenment tried to avoid all conceptual impositions. Their theories never intended to violate or modify perceived reality. Thus the development of a geometrical theory of perspective was arrested during the eighteenth century, and works like Desargues's, which implied a different attitude to reality, were ignored by practicing artists.

The most influential work showing this transformed notion of perspective was, perhaps paradoxically, Andrea Pozzo's *Rules and Examples of Perspective for Painters and Architects*. This book, published in Latin between 1693 and 1700, was the result of Pozzo's vast practice, itself a significant part of the Jesuit contribution to Baroque art. Avoiding the geometrical theory of perspective, Pozzo's theoretical discourse amounts to a collection of extremely simple rules and detailed examples of perspective constructions, which always begin from the plan and elevation of a building.[25] In 1720 a well-known mathematician, J. Ozanam, defended this revised conception of perspective in his *Perspective Théorique et Pratique*, which maintained that the sole objective of this science was the imitation of nature. Ozanam criticized those authors who had opposed perspective and who accused it of being a useless art, pleasant to the eye, but only through constant deception. True, some charlatans had indeed committed abuses in its name, relating it to magic and superstition, but this, he thought, was nonsense. Perspective was only a vehicle for reproducing "the marvelous world of man" from a given point of view.

Taking their cue from this purification of perspective, architects and artists of the eighteenth century showed no interest in the illusionistic tricks and exaggerations that were so popular during the Baroque period. The world of illusion was distinguished from the world of everyday life. Man's position vis-à-vis the objective physical reality of the world was defined more clearly, and this, in turn, led to the beginning of anthropological speculations.[26]

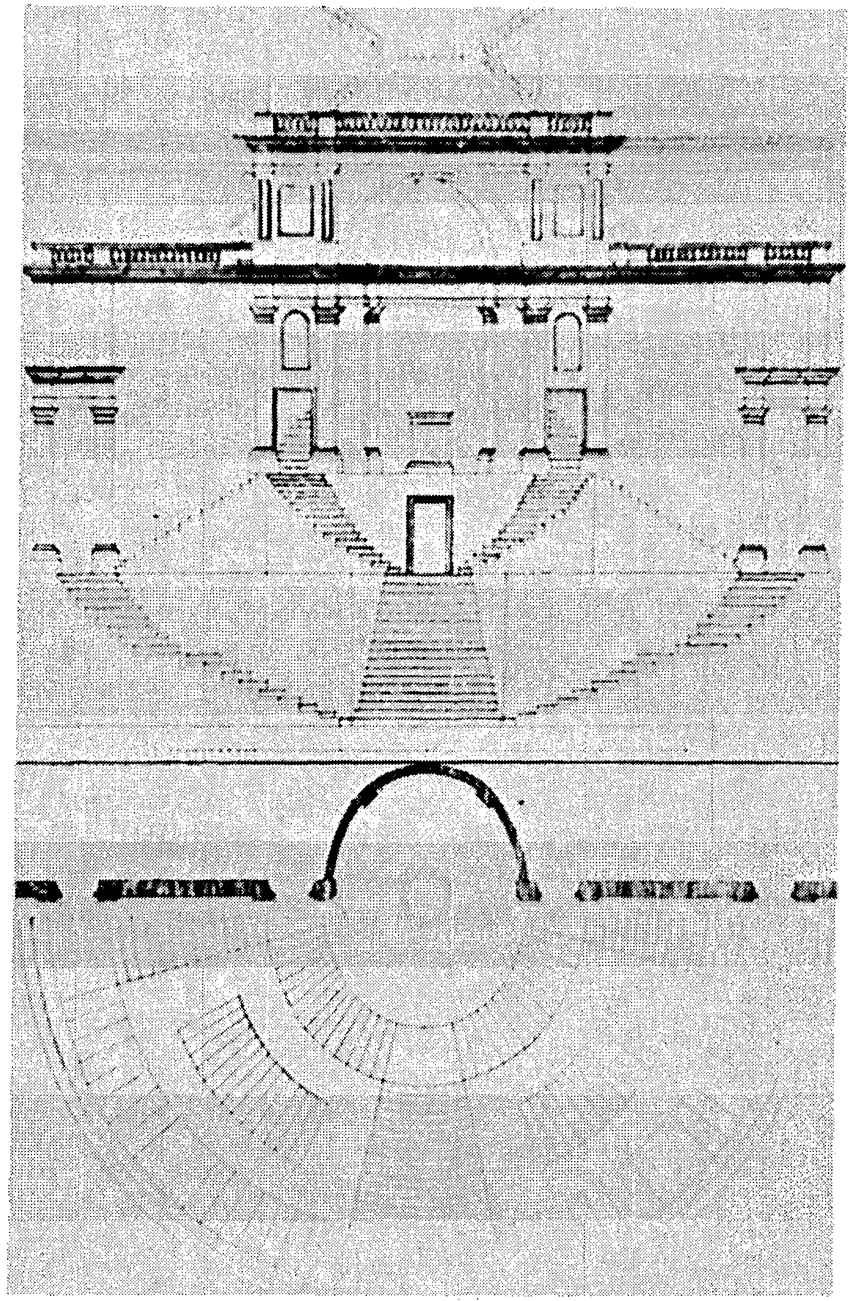
Enlightened reason became a force whose task was to transform reality into a universe of representation. This notwithstanding, a metaphysical channel remained open between the stage and the spectator, between *res extensa* and *res cogitans.* Truth appeared in the observation of phenomena, and intersubjective communication remained possible. This meant that perspectivism, a condition and result of the radical dualism of modern philosophy, could not achieve its ascendency over perception until the end of the eighteenth century.

It is significant that in contrast to the great number of philosopher-mathematicians of the seventeenth century, during the Enlightenment, only d'Alembert, Wolff, and perhaps Euler can be called such. By 1754 Diderot observed a "great revolution" taking place in the sciences and predicted that in a hundred years there would not even be "three geometricians left in Europe. . . . The progress of this science will suddenly stop."[27] Indeed, after mid-century the interest in abstract speculation declined sharply in favor of experimental physics and natural history. Any geometrical system, including Newton's, could be accused of imposing a false structure upon the diversity of nature.[28] Geometry as a formal science was not developed at all during this period and lost its predominant role as a prototype of knowledge.

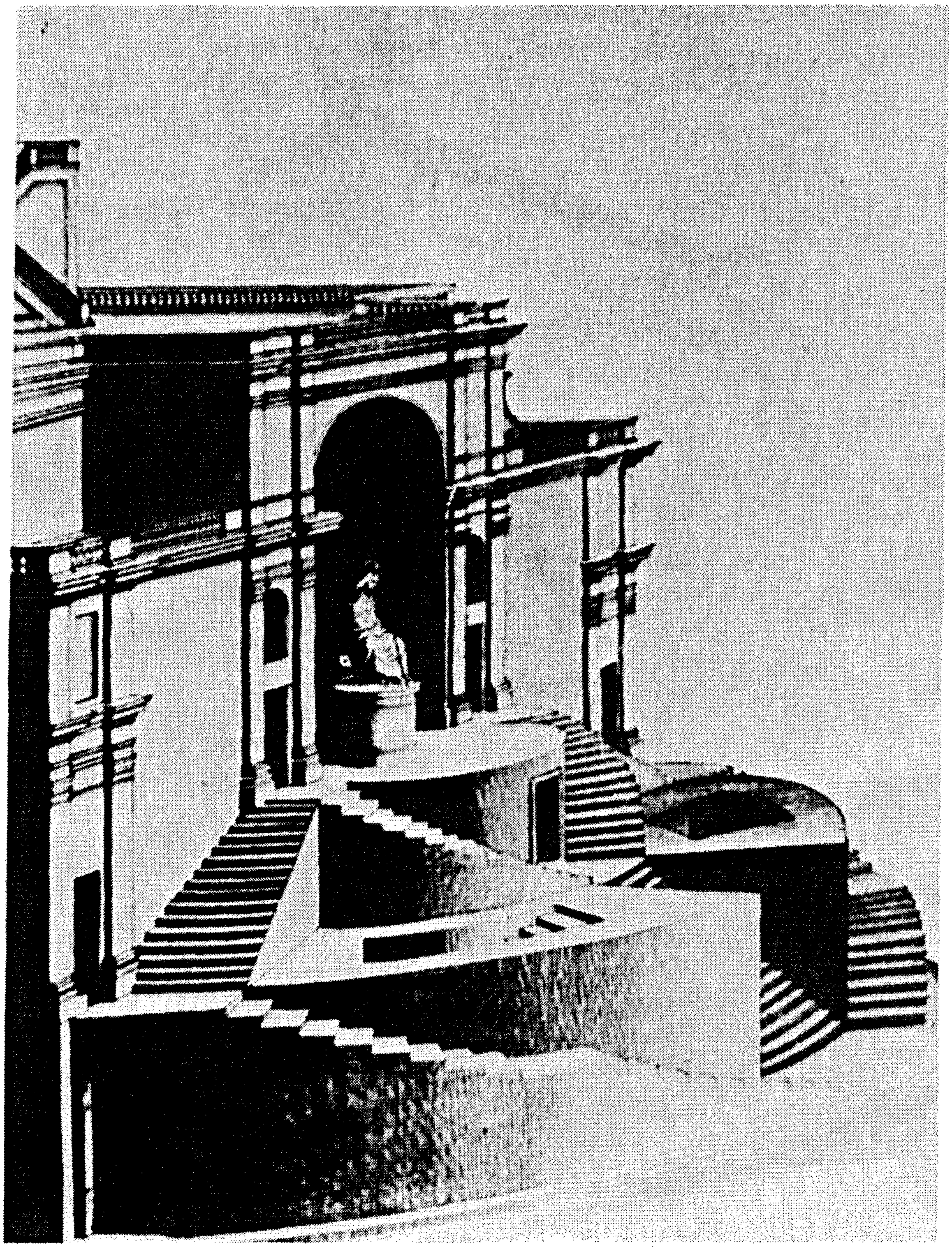
In this transformed epistemological framework, geometrical operations were seldom used in architectural design, although they were widely applied in other technical disciplines related to architecture, such as surveying, mensuration, stereotomy, and statics. But their use in generating architectural form and meaning was ambivalent and sporadic, usually appearing elsewhere than at Paris or Rome, the cultural and architectural centers of Neoclassicism.

Geometrical Operations in Eighteenth-Century Design

The direct influence of Guarini on Central European architects was considerable during the early eighteenth century. In the Piedmont, Bernardo Vittone followed the example of his master. Vittone was born in Turin in 1705 and was responsible for the publication of Guarini's *Architettura Civile.*[29] Traditionally, his work had been classified with that of other Austrian and German architects as late Baroque. His use of formal elements and his geometrical combinations were clearly borrowed from Guarini, but his buildings seem to betray a less confident and systematic spirit.



Perspective constructed from a precise plan and elevation, after A. Pozzo's *Rules and Examples of Perspective* (1709).



However, Vittone's architecture should not be dismissed for these reasons. His important place in the debate between Baroque and Neoclassical architecture has recently been established.[30] Vittone's theory and practice was the result of a conscious, although never rigorous, synthesis of diverse interests. A devout Catholic, he had been impressed by Newton's cosmology, which he knew through Algarotti's interpretation.[31] His library included the most important architectural treatises, several editions of Vitruvius, and other less-known books, such as *Architectura Civil, Recta y Obliqua* by Guarini's enemy, Caramuel de Lobkowitz, and Carlo Fontana's *Tempio Vaticano*. He was passionately interested in rhetoric and science. In his library was a book by A. Bosse on the drawing of the classical orders using a geometrical method (a possible precedent of Osio and Guarini), as well as works on physics, astronomy, mechanics, and optics. He had copies of Galileo's *Dialoghi*, a course on mathematics by Ozanam, and Bélidor's most important work, *La Science des Ingenieurs*.[32]

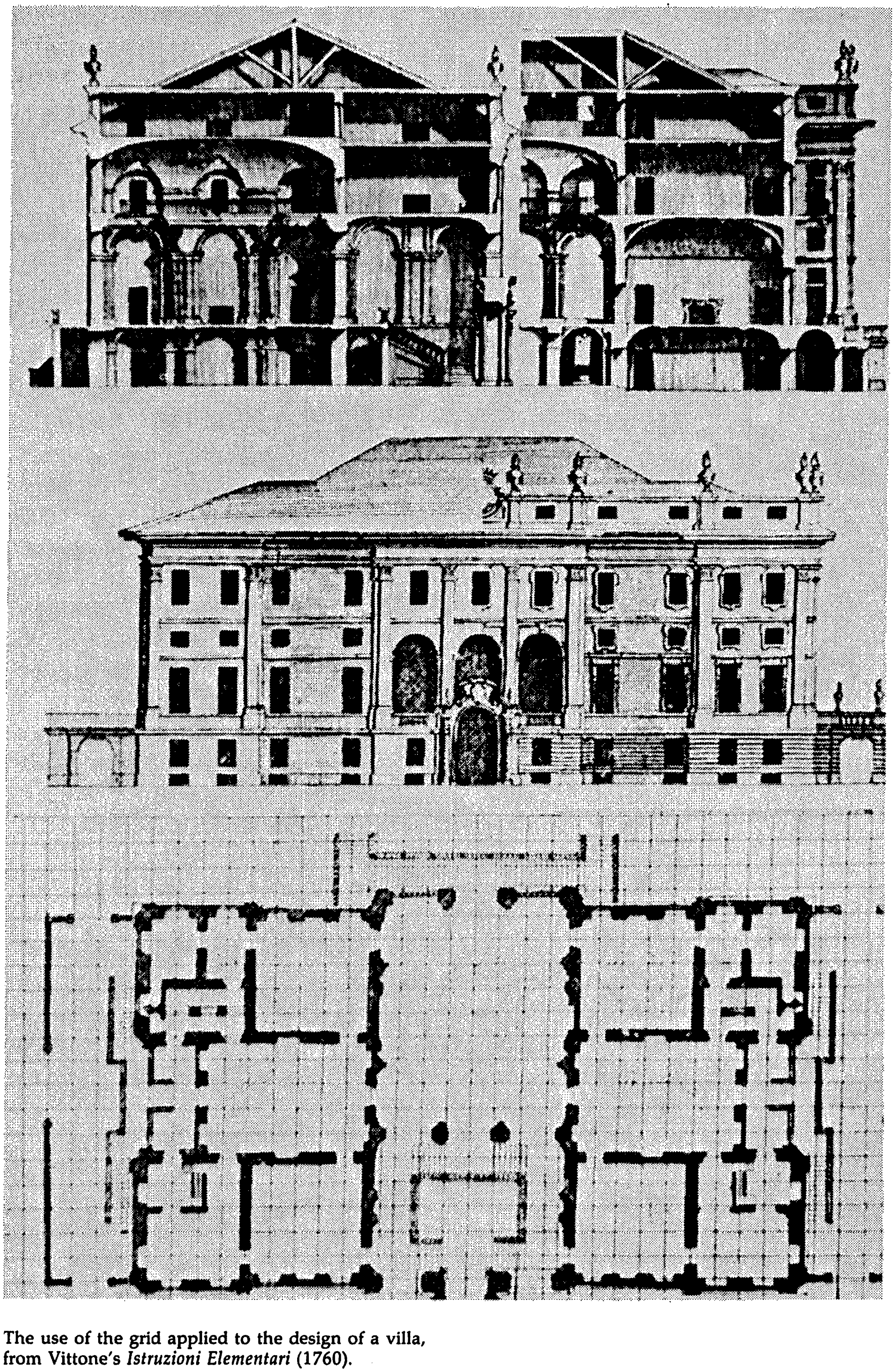
Vittone, who always added to his signature the title *ingegnere*, was very interested in technical problems of construction and was aware of the recent French contributions on the subject. His theory of architecture was published in two enormous, often redundant, treatises entitled *Istruzioni Elementari* (1760) and *Istruzioni Diverse* (1766), dedicated to God and the Virgin Mary. Both books betray the same interests. In *Istruzioni Diverse*, Vittone dealt with mensuration, hydraulics, property evaluation, bridge construction, "and all types of buildings and ornaments of civil architecture."[33] He included methods of calculating areas and volumes of complex vaults and the precise dimensions of the Italian mile in relation to the spheroidal shape of the earth. In the section on the design and construction of bridges, he mentioned Bélidor's work. Still, Vittone did not refer to quantitative considerations resulting from the strength of materials; his recommendations for the proportions of piers were wholly conventional, taken mostly from the best-known Renaissance treatises. In the chapter on vaults, he pointed out the difficulties involved in determining the "convenient thickness" of the upper sections in order to make them sufficiently resistant.[34] He then tried to apply some principles of statics to the problem, devised a formula, and used it. In the end, however, Vittone repeated L. B. Alberti's advice on the dimensions of vaults. Indeed, if Vittone's work is compared to contemporary French and Italian Neoclassical treatises, including the *Rigoristti*, his lack of interest in mechanics and quantitative experiments is remarkably conspicuous.

Vittone faced great difficulties when trying to provide a method for quantifying and evaluating buildings or property. His categories for determining the monetary value of buildings were mostly qualitative, never merely material or quantitative. His traditional perception of the world created a confusion between qualities and quantities that was already normally avoided in books about mensuration.

One of the more interesting aspects of Vittone's theory is his emphasis on the use of a grid to solve design problems, particularly the distribution of such architectural elements as columns, walls, and openings in plan. He included a great number of plates in which the grid was used for the determination of plans of buildings and gardens, for the composition of elevations, and as the basis for tracing abstract geometrical figures or emblems. Vittone's use of the grid anticipated by more than forty years Durand's "mechanism of composition," a method of design recommended solely for purposes of efficiency. Vittone's grid was obviously no longer the symbolic reticulation of De l'Orme's *Divine Proportion* or that of Cesariano's representation of Vitruvius's man. It was a practical device for providing simple rules for determining the proportions and locations of rooms, doors, and windows. No longer a network of invisible lines to elucidate architectural meaning, the grid became a mere instrument for simplifying the design process.

In view of our previous discussion, however, the technological implications of Vittone's use of the grid should not be overemphasized.[35] For though he seemed genuinely concerned with statics, his comprehension of structural problems was narrow. He may have known Borra's treatise on strength of materials and Poleni's collection of reports on the structural problems of Saint Peter's Basilica in Rome, both published in 1748; but the tracing he provided in *Istruzioni Diverse* for the correct configuration of a dome is a modified version of Carlo Fontana's method, as it appeared in his *Tempio Vaticano* (1694). This was a truly Baroque set of geometrical operations, not derived from mechanical considerations, but endorsed by their immanent symbolic power and the actual existence of exemplary models that embodied this geometry.

Vittone also studied the works of Newton, though he never seemed to understand the importance of empirical, quantitative knowledge. He was concerned mainly with the poetic dimension of Newton's Platonic cosmology. Like Briseux, Vittone identified musical with architectural harmonies and considered Newton's optical theory, which explained mathematically the separation of



The use of the grid applied to the design of a villa, from Vittone's *Istruzioni Elementari* (1760).

white light into the seven colors of the rainbow, to be the supreme confirmation of traditional theories of proportion. The careful and mysterious use of light in Vittone's churches had its origin in the archaic horizon of Neoplatonic belief. Light was a traditional symbol of divinity, now made explicit through its newly discovered qualities and magical properties. Newton's acute empiricism, however, could never determine the true essence of light. Its mystery, similar to that of the gravitational force, always fascinated Newton, just as it did artists, poets, and architects, for whom it became a source of inspiration.[36]

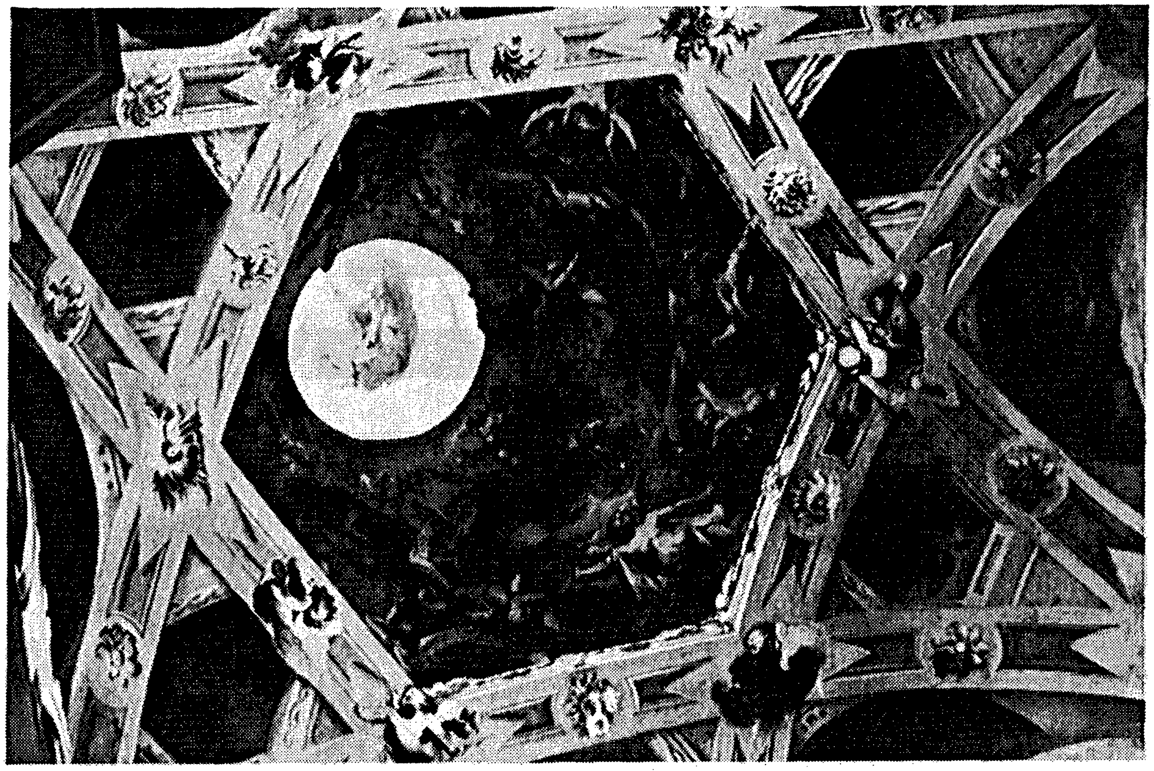
To the *Istruzioni Diverse*, Vittone added a short piece on the nature of music and harmonic proportion by a close associate.[37] In a short introduction, Vittone evinced skepticism about Plato's and Hermes Trismegistus's idea that music is a "science of order, according to which are disposed all things in nature."[38] He also questioned the marvelous and magical character of a "universal architecture," though he considered an understanding of the universal laws of harmony necessary to establish rules for the design of theatres, communal halls, basilicas, and choirs, where a consideration of acoustics was essential. Thus Vittone endorsed his disciple's piece, which was an attempt to apply "scientific" principles to the problems of harmony and represented, in effect, a corpuscular theory of sound. The author analyzed "extrinsic" and "intrinsic" properties of sound: sonority, propagation, "dilatation" or the "periodic order" of harmonic elements—all of which he defined in terms of "atoms of sound." He compared them to "atoms of light" and imagined them traveling through the ether. He studied their form, elasticity, and dimensions, postulating an analogy between atoms of sound, atoms of fire, and atoms of water. Mathematical harmony constituted the essense of this analogy because, as Galileo had shown, "nature is mathematical in all that concerns physical things and their functions."[39]

These theories were partly derived from seventeenth-century physics, having their roots in a traditional cosmobiology. Not surprisingly, the author also emphasized the symbolic character of certain numbers. The number 2, for example, was "meaningful and mysterious," since it was always present in harmonic consonances; its symbolic character was reinforced by the fact that number 22 determined the "totality of the musical system."[40] This is also the number of letters in the Jewish, Chaldean, and Syrian alphabets; it is the number of ancient canonical texts and the number of patriarchs, judges, and kings. After a similar study of the character of number 7, the author concluded that "in view of such and so many mystical correspondences," it was unquestionable that harmony was a science in which God had deposited conspicuous signs of His most sublime and admirable secrets.

Vittone's conception of number and his use of geometrical operations were ambivalent; although half-conscious of the implications of modern science, they also derived from traditional considerations. His use of the grid as a tool of design and his interest in Newton and in the works of French engineers seemed to be a move away from the transcendental theories of his Baroque predecessors. But in the end, his profound religious convictions and the formal architectural expression that he had inherited from Guarini prevailed. Assimilated at a certain level with the Platonic cosmology of natural philosophy, his geometrical structures were never as overpowering as Guarini's. In his humble churches, the structure was always subdued by the presence of light.

The use of a grid as an instrument to simplify the design process and to make explicit the proportions of the components of an architectural plan also appeared in a less-known work, the *Instituzioni d'Architettura Civile* (1772) by Nicola Carletti. To Carletti, architecture was a science, and his aim was to guide young architects through "the purest doctrines," toward a "universal practice of their art."[41] Without quibbling, Carletti declared his fervent adherence to Newton's philosophy. His own wish, then, was to implement in architecture the analytical methods that the British scientist had discovered. For Carletti, "the culmination of human knowledge" consisted in a series of observations and experiences from which were obtained general principles through induction.[42]

Carletti claimed that his work was thoroughly modeled on Newton's "system" and gave two reasons for his choice. In the first place, he wanted to provide "simple meditations" founded on few data, instead of a "long series of irritating arguments." His second reason was more interesting. Carletti realized, as did Perrault, that architecture was related to custom. After a brief historical analysis, he expressed a pragmatic view of primitive architecture, showing it to be simple, unrefined, and guided by the sole objective of defending man against the elements. Beauty, solidity, and commodity, the three categories that constituted the main objectives of architecture, were to be founded on the investigations, approval, and institutions of wise men "that had opened the way toward truth, through reasons considered as absolute principles." But while Perrault upheld Vitruvius's treatise



View into the dome of Vittone's Sanctuary of Vallinoto, near Carignano in the Piedmont (1738–1739).

and provided his own rules in the *Ordonnance*, Carletti took Newton as his source. Geographical and cultural differences notwithstanding, architecture, for Carletti, was an extension of nature and therefore was grounded in absolute principles. The search for truth and its application was the declared motif of his analytical system. Ironically, the form of the text was *more geometrico*, a collection of definitions, observations, experiments, corollaries, schollia, and rules, reminiscent of the previous century.

Carletti surveyed various types of buildings and used a grid to describe his project for a jail, placing the walls on the lines and columns on the intersections. His proportions were stipulated in terms of natural whole numbers. He was genuinely interested in the strength of materials and statics. In the *Istituzioni*, he provided empirical rules concerning the properties of building materials. The second volume of his work was totally devoted to such technical problems as topography, the geometrical determination of the shapes of vaults and arches, mensuration of parts of buildings and quantification of their cubic volumes, and a method for finding the real dimensions of buildings starting from their general proportions.

Yet alongside his modern preoccupations, Carletti also retained traditional notions about proportion. He believed that architectural harmony and proportion had their origin in the human body, which he proved in the Vitruvian fashion. In a section on the determination of proportions of vertical structural elements, he was unable to distinguish between dimensions obtained through the application of statics and those simply prescribed by the traditional rules of proportion. It was only in relation to sacred buildings, however, that he emphasized the crucial importance of harmony and proportion. These buildings, which he saw as being dedicated to the God of the Enlightenment, the "Supreme Maker" or "Divine Unity," should be places conducive to the "perfect adoration and contemplation of INFINITY."[43]

Carletti's understanding of architecture vis-à-vis sacred space has important implications on which I shall elaborate in the following chapter. During the Middle Ages, the symbolic order revealed by architecture concerned fundamentally the cathedral, the City of God, the only immutable and transcendental building. The finite order of the city was not an architectural problem strictly speaking, except perhaps on the occasion of religious celebrations, when the ideal geometrical order was made manifest in the structure and staging of a mystery play.[44] In the Renaissance, human life acquired a new value as lived experience. The architect was concerned with the city as a stage for the drama of humanity, now liberated from religious determinism but nonetheless devout. Through the seventeenth century, the symbolic geometrical order of both secular and religious institutions was indeed the task of the architect, striving to give man a dwelling place for his image, reconciling his finitude with eternity. In order to understand the origins and possibilities of modern architecture, it must be noted that once the human world and its institutions became truly secularized in the eighteenth century, the symbolic intentionality of architecture became strongly associated with theoretical projects of sacred (and funerary) buildings.

Carletti admitted to having been influenced by the work of the German philosopher Christian Wolff, who himself had been the most important disciple of Leibniz. It was Wolff's disregard for the transcendental implications of Leibniz's cosmological synthesis that intimated a philosophy that no longer depended on theology, and would eventually become a critique of reason.

Wolff spent his life attempting to achieve a total systematization of human knowledge. His general metaphysics would become during the nineteenth century the general philosophy of positivism. He tried to organize all available information, transforming it into a "true science." His objective was to create a system in which the principles would be the obvious origin of their own consequences, a system where everything could be "deduced with demonstrative evidence." He wrote that after "having meditated on the foundation of evidence in geometrical demonstrations and on the techniques of research in algebra," he was able to establish "the general rules of demonstration and discovery."[45]

Wolff's philosophy is a good example of how the Newtonian model was applied early on to the human sciences. His numerous writings are all characterized by a mathematical structure, very similar to the metaphysical systems of the seventeenth century, but without their guarantee of absolute transcendence. His formal a priori systems imitated in a sense the perfect intelligibility of Newtonian thought. Wolff's stated intention was to do for metaphysics what Newton had achieved in his physics: to define it through the unification of "reason and experience."[46] In his *Elementa Matheseos Universae* (1713), for example, he tried to implement this synthesis. The text was structured *more geometrico*. Alongside specific sections on civil and military architecture, it included those disciplines that had been or were to become part of the education of eighteenth-century engineers and architects: mathematical method, arithmetic, geometry, trigonometry, finite and infinite analysis, statics and mechanics, hydraulics, optics, perspective, gnomonics, and pyrotechnics.

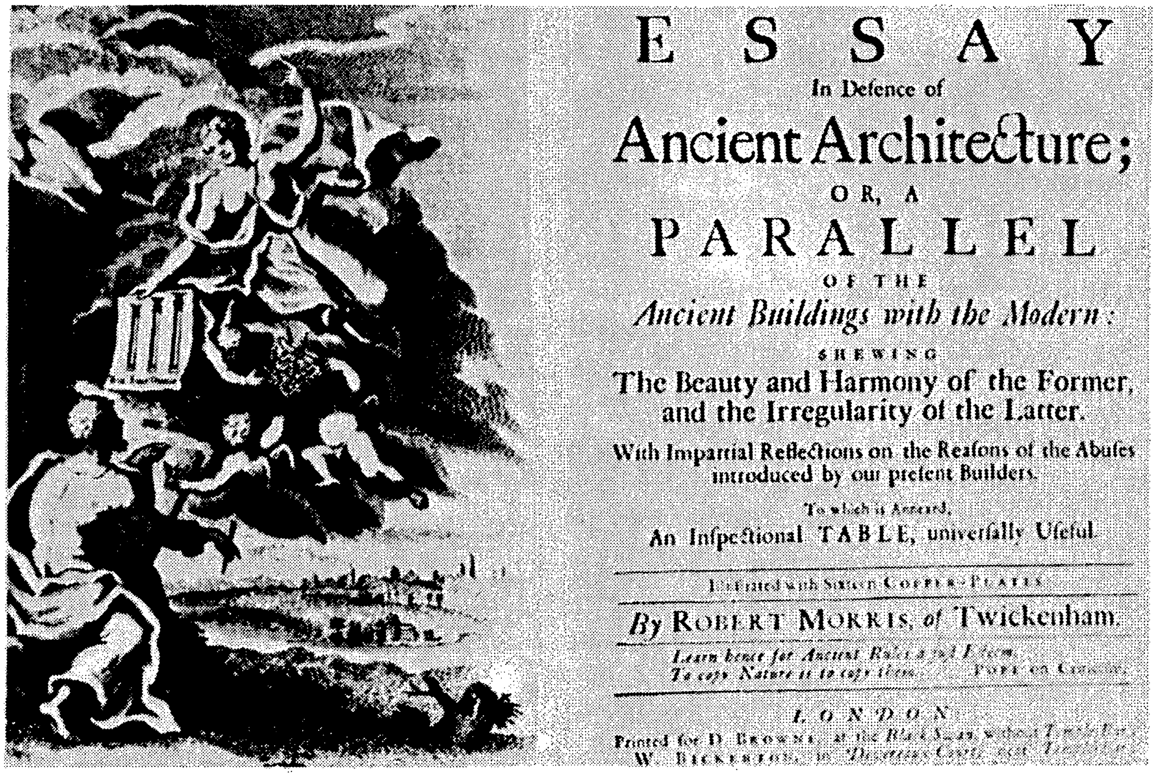
This interest to axiomatize knowledge in a world where such operations were still impossible determined the ambiguity of the work of philosophers like Wolff and d'Alembert, an ambiguity that was shared by the infrequent attempts of absolute systematization in eighteenth-century architecture. During the Enlightenment, the dilemma was solved by invoking the transcendental sense of Nature. Both Wolff and Carletti depended upon Newton's discoveries to justify their own geometric and aprioristic intellectual structures—structures that the English scientist himself would have rejected. Induction and encyclopedism normally avoided the contradictions between mathematical systems and empirical reality by discouraging any excessive mathematical formalization of knowledge.

The section on civil architecture in the *Elementa,* like Carletti's *Istituzioni,* was structured *more geometrico.* Wolff's theory was still fundamentally Vitruvian and included the classical orders. Concerning proportion, Wolff made no explicit reference to its symbolic content, but insisted that the optimal dimensional relations were defined by natural numbers "easy to recognize by the human sight." His theory was similar to that which Laugier would put forward in his *Observations,* almost sixty years later. Wolff introduced three categories by which to recognize the perfection of proportions in relation to a mathematical rationalism that, he believed, corresponded to perceptual intelligibility. His fundamental criterion was the clarity with which proportion was presented, becoming better as it approached the square and avoided small fractions.[47]

Wolff reproduced the proportions for the classical orders recommended by Goldmann, one of the least-known traditional authors. However, he also included systematic tables for determining the dimensions of certain ornamental elements, numerical rules for the design of chimneys, and geometrical methods for tracing various details. It is significant that the anonymous translator of the French edition of the *Elementa* (1747) decided to substitute Goldmann's proportions ("in such bad taste") with Perrault's.[48] His decision was explained in a "corollary" to the text that underlined the relative unimportance of following scrupulously the original recommendations of Wolff. The translator thought that proportions could be slightly modified without endangering the beauty of a building, and no doubt recognized certain essential affinities between Wolff and Perrault, particularly their emphasis on mathematical systematization and their understanding of theory as a formal discipline capable of being structured apart from metaphysical speculations. Wolff's own protopositivism, however, was restrained by the implicit metaphysical dimension of Newtonian natural philosophy; his systematization was still a metametaphysics, not an actual positivism.

In eighteenth-century England, there were also some sporadic applications of geometry in architectural design, particularly among the "architect-surveyors". One instance is the work of Robert Morris, who on the surface appears as a very traditional architect, insisting that good taste necessarily derives from an intimate acquaintance with the work of the ancients. His admiration of Palladio, so popular in England during the early eighteenth century, was unconditional. He called him "the chiefest restorer of antiquity."[49]

In 1728 he published *An Essay in Defence of Ancient Architecture*, which was concerned with the criticism of modern "follies" and excessive use of ornament. He added a rather lengthy introduction as a key to his architectural intentions. In an exalted poetic vein, Morris emphasized the symbolic sense of Nature; he referred to it as the "architectural Creation of the World" and as a manifestation of "Divine Power."[50] After praising the Royal Society of London and the Baconian concept of mutual assistance for the advancement of science, he declared his faith in a universal harmony. Morris clearly revealed the poetic dimension of natural philosophy: fantastic visions of microscopic worlds, planets, animals and plants—everything ordered in a cosmic totality where it was possible to perceive "the mysterious act of Divine Wisdom." But apart from this, when he tried to describe the prototypical image of traditional cosmobiology, his words lacked conviction: "We are not a little pleased says a great author . . . when we compare the body of man with bulk of the whole Earth, the Earth with the circle it describes round the sun, the circle to the sphere of the fix'd stars, the sphere of the fix'd stars to the circuit of the whole creation."[51] In the end, his conclusions about architecture were not very ambitious. Like Carletti long after him, he specifically addressed sacred architecture, which he claimed would be more pleasant if it resembled the works of nature.


ESSAY
In Defence of
Ancient Architecture;
OR, A
PARALLEL
OF THE
Ancient Buildings with the Modern:
SHEWING
The Beauty and Harmony of the Former,
and the Irregularity of the Latter.
With Impartial Reflections on the Reasons of the Abuses
introduced by our present Builders.
To which is Annexed,
An Inspectional TABLE, universally Useful.

By ROBERT MORRIS, *of* Twickenham.

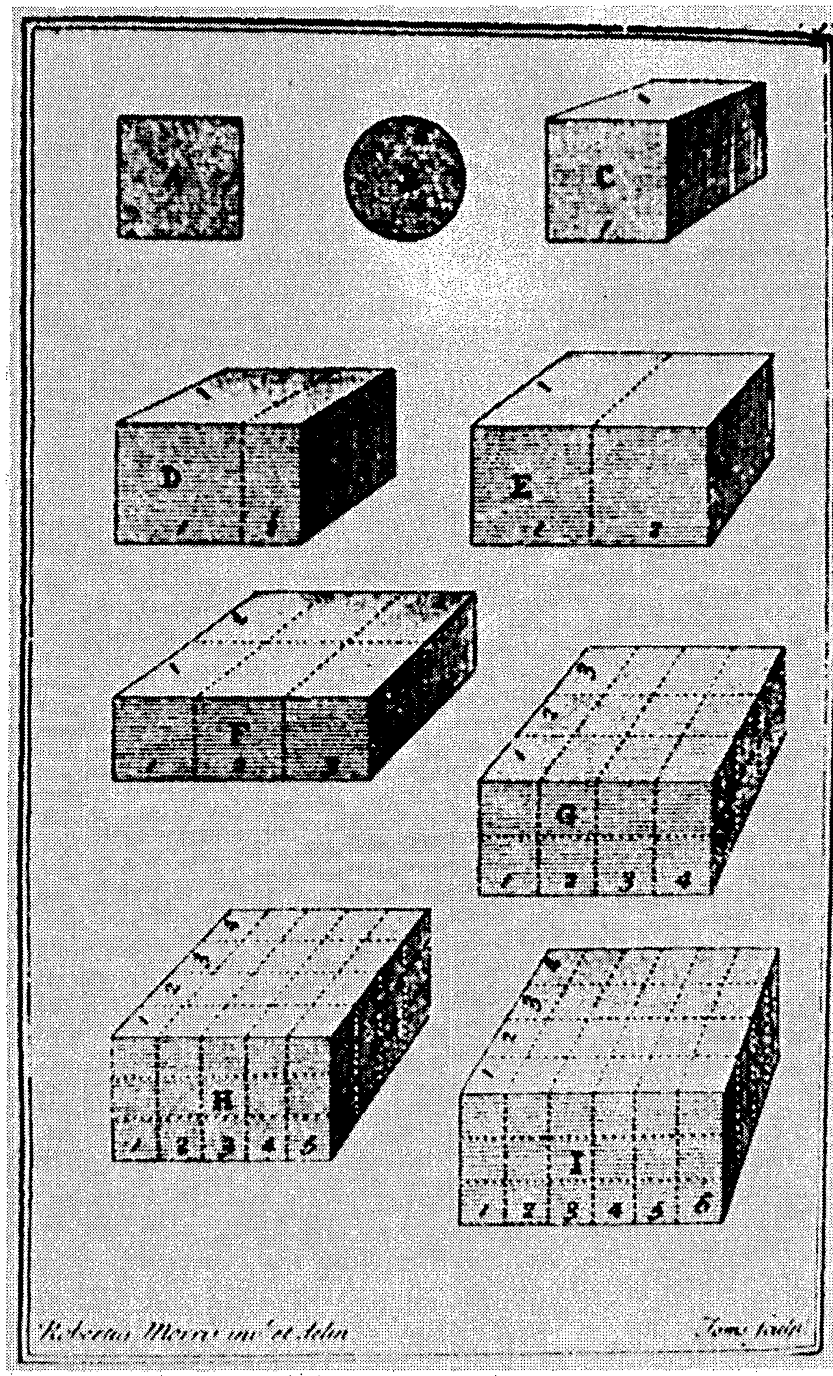
LONDON:

Frontispiece and title page of Morris's *Essay*. Notice the allegory of revelation of ancient rules and Pope's quotation.

In his *Lectures on Architecture,* Morris wrote more extensively about the use of proportions and geometry. His purpose was to determine what "true proportion and harmony" really were, so that it might be possible to establish practical rules. He believed that, regardless of whether harmony resided "in numbers or Nature, it immediately strikes the Imagination by some attractive or sympathizing property."[52] These were obvious echoes of Newtonian harmony. But Morris also believed that architects should know geometry in order "to delineate regular or irregular plans, etc., to furnish him with reasons for the capacity of supporting weights," and to trace perspectives, sections, and elevations. And they should be acquainted with arithmetic "for estimates, measurements," and "money spended," and be familiar with "Musick . . . to judge their accords and discords and affinity with proportion, in erecting places such as Rooms of Entertainment, Theatres, Churches in which Sound is more immediately concerned."[53]

Morris apparently recognized the formal dimension of mathematics as a technical tool in architecture. His interest in musical harmony, however, did not stem merely from a concern with acoustics. Explaining his system of proportion, Morris pointed out that through music, nature has taught Mankind certain rules of "Arithmetical Harmony." These were the rules of proportion that he adopted for architecture: "The Square in Geometry, the Unison or Circle in Music and the Cube in Building have all an inseparable Proportion; the Parts being equal . . . give the Eye and Ear an agreeable Pleasure, from hence may likewise be deduc'd the Cube and half, the Double Cube; the Diapason and Diapente, being founded on the same Principles in Musick."[54] Immediately thereafter, Morris declared his preference for natural numbers in architectural proportions and established the maximum dimensions of his modular cube. The use of modular cubes unquestionably simplified the conception of architectural volumes. The technical dimension of his concern with proportions was particularly evident in a chapter on chimneys, in which he sought to discover the "arithmetic and harmonic proportions" of chimneys in relation to the dimensions of rooms and to provide simple and universal rules for their design.

Having established an analogy between musical harmony and architectural proportion, Morris decided that to the seven "distinct" notes of the musical scale there corresponded seven proportions in architecture that could be clearly differentiated: Architectural



The generation of cubic proportions in architecture, from Morris's *Lectures on Architecture* (1734).

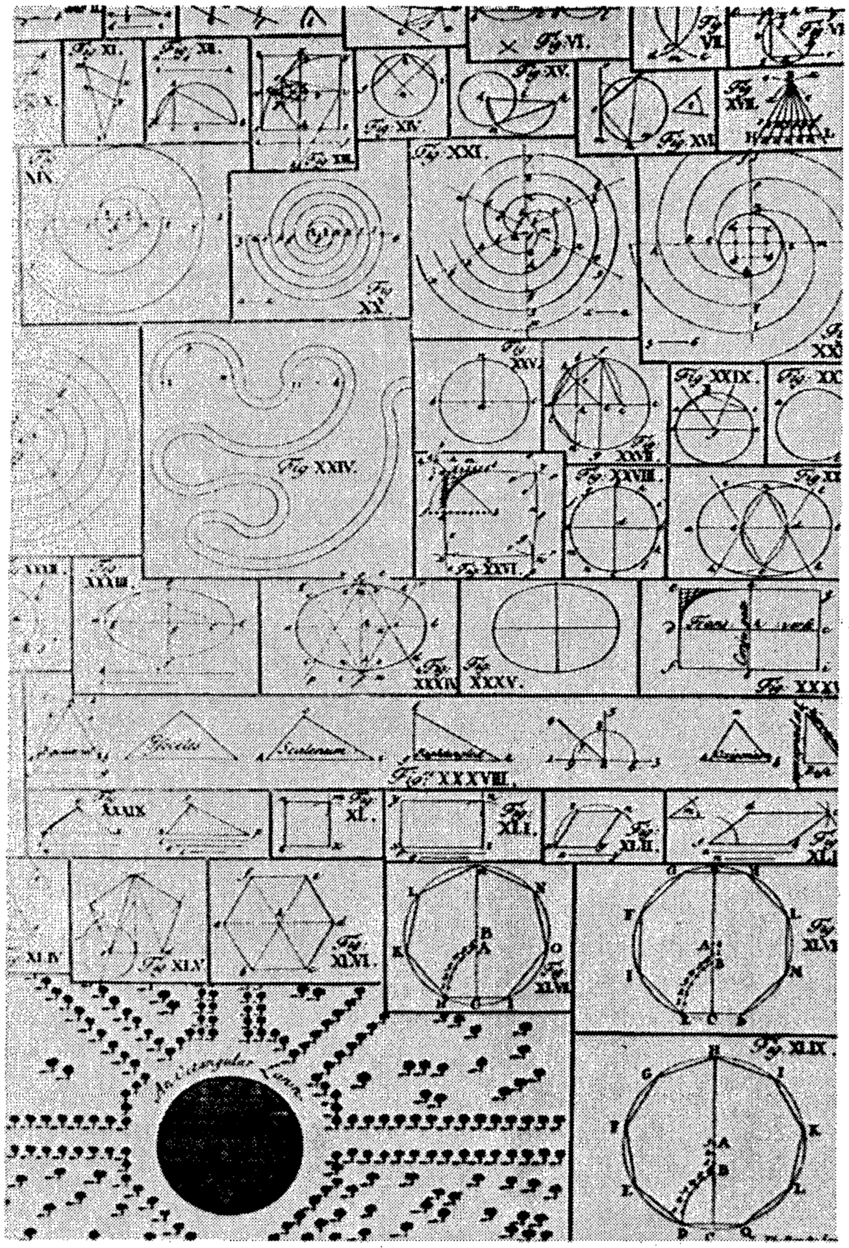
proportion "difuses itself to the Imagination by some sympathizing Secret to the Soul, which is all union, all Harmony."[55] In *An Essay upon Harmony* (1739), Morris emphasized that the harmony of nature consisted in proportions, which originated in the human body. He included a quotation from Shaftsbury: "Nothing surely is more strongly imprinted in Our Minds . . . than the idea or sense of order and Proportion; hence all the force of Numbers, and those powerful arts founded on their Management and Use."[56]

Obviously, Morris was aware of the metaphysical foundation of natural philosophy, and he invoked this outlook to provide the ultimate validity of his architecture. Nevertheless, his use of geometry as a design tool still appeared as a merely technical operation, equivalent to geometrical applications in statics, surveying, and mensuration. It should be remembered that the ambiguity present in the use of mathematics by eighteenth-century architects also appeared in Newtonian science itself. On the one hand, and on a practical level, Newton attested that geometry derives from mechanics; on the other hand, the geometrical order of his Platonic cosmology was a primordial symbol of God's participation in Being, confirming the significance of human action in an infinite universe.

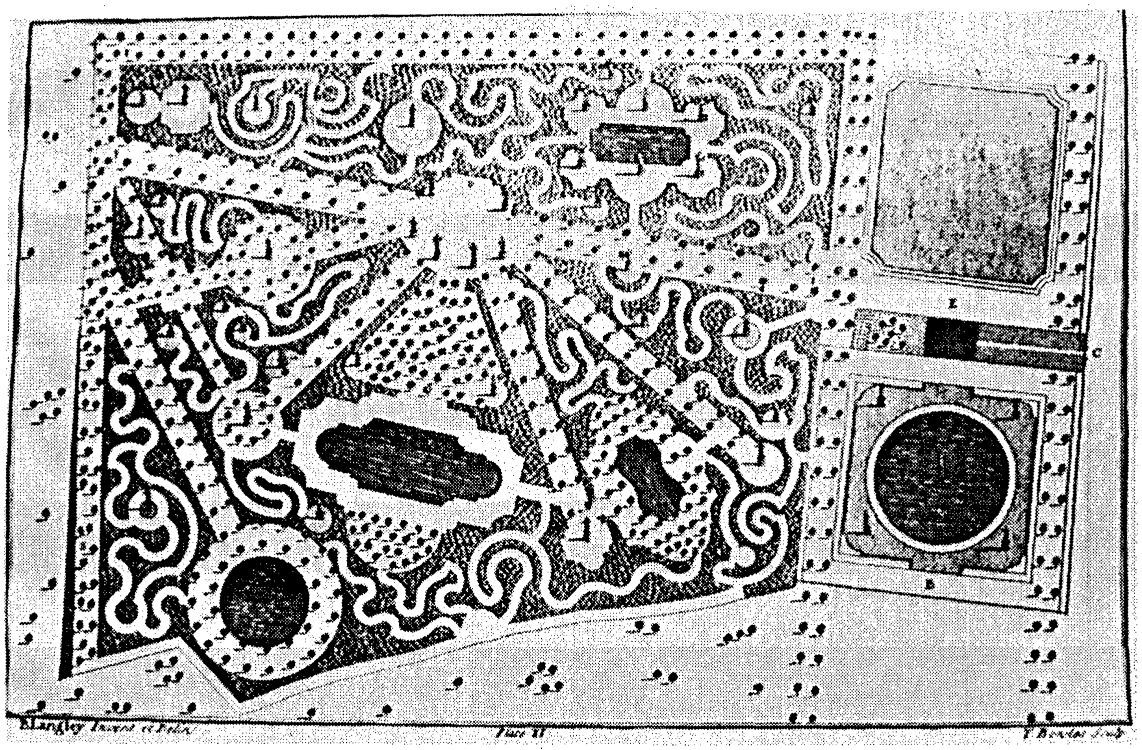
The work of Batty Langley, a defender of the English garden and contemporary of Morris, was developed within a similar framework, but with an additional important dimension. Throughout Langley's work, there is a marked emphasis on the necessity to apply geometrical operations to all sorts of architectural problems. Geometry was not a means for formal innovation, but rather a tool for resolving traditional questions, in the manner proposed by Osio and Bosse. For Langley, geometrical operations were indispensable for the conception and execution of buildings.

In 1726 Langley published his *Practical Geometry Applied to the Useful Arts of Building, Surveying, Gardening and Mensuration,* which provided the definitions, theorems, and axioms of Euclidean geometry as a necessary foundation for all the building crafts. This supposition of a general geometrical theory is quite exceptional during the eighteenth century. Langley applied it to the description of spiral lines in gardening, tracing classical orders, and drawing plans and elevations of labyrinths, groves, cities, parishes, estates, and "wildernesses."

Aware of the different proportions recommended by the great masters for the classical orders, Langley decided, like Perrault, to use approximately average dimensions. But he gave little im-



Introduction to the operations of Euclidean geometry, from Langley's *Practical Geometry* (1726).



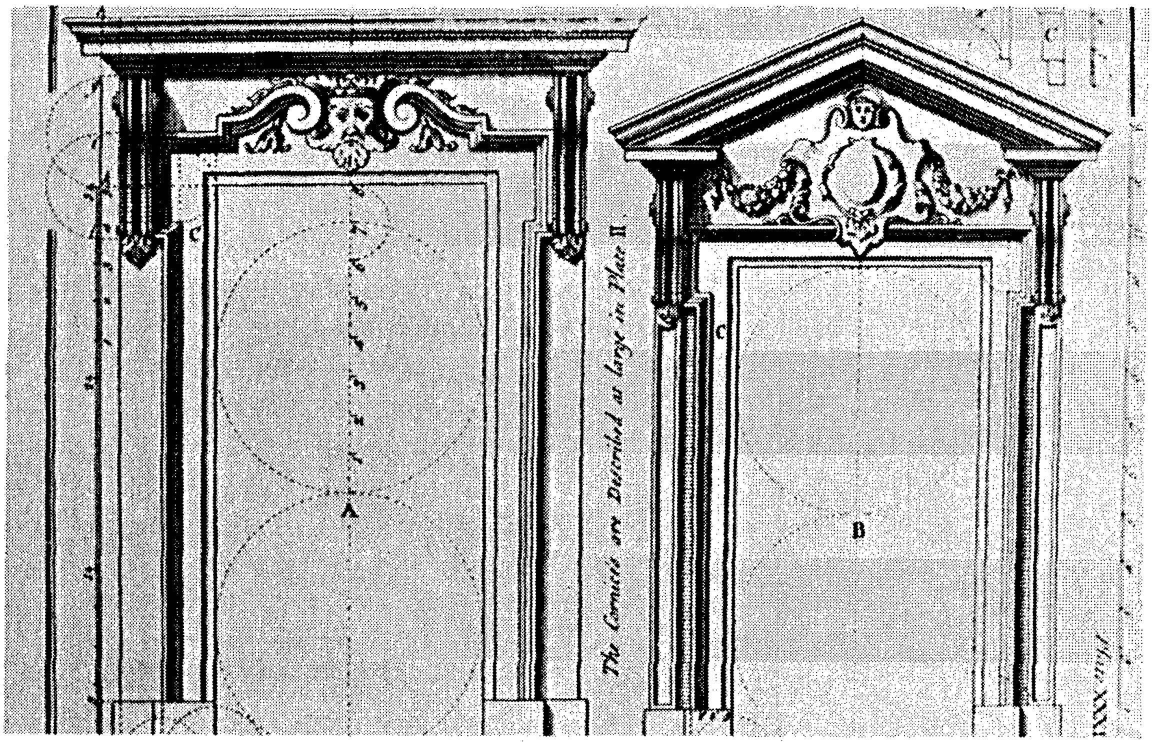
Design for an English garden from Langley's *Practical Geometry*.

portance to the specific numerical proportions. Instead, he provided precise geometrical instructions by which to draw the orders and their details, simplifying as much as possible the operation of design. A scale of his own invention was to be used to determine the dimensions of mouldings and flutings in relation to the heights of columns. Significantly, his *Gothic Architecture Improved by Rules and Proportions* advocated the same methods. Geometrical operations were obviously his main concern; they were perceived as fundamental, regardless of stylistic differences. Langley proposed five "gothic orders," which were constructed on the basis of geometrical tracings.

Langley avoided the symbolic implications of geometry. *The Builder's Compleat Assistant* (1738), examined trigonometry, topography, stereometry, and Newton's laws and considerations about statics, mechanics, and hydrostatics. It discussed complex applications of geometry to many problems of construction, such as stairs, vaults, and scaffolding, and included Palladio's system of proportion and one of his own invention. In *A Sure Guide to Builders* of 1729, after a long introduction devoted to geometry, Langley reproduced the proportions of the classical orders by Vitruvius, Palladio, and Scamozzi, adding a geometrical tracing of each one of the respective orders.

In apparent contradiction to his own technical interests and to the views expressed by his Baroque predecessors, Langley *never* questioned the value of ancient authority. His unconditional respect for the texts and buildings of the past, together with his passion for geometrical operations and technical problems of construction, appears as a perfectly coherent aspect of his theory. This can only be explained through Langley's militant affiliation to Freemasonry, whose ideology reinforced the ethical and moral values implicit in natural philosophy. Langley published in 1736 two large volumes entitled *Ancient Masonry Both in the Theory and Practice*, where he provided "Useful Rules of Arithmetic, Geometry and Architecture in the Proportions and Orders of the Most Eminent Masters of All Nations."

The content of this work is, significantly, similar to all his other works on architecture. It included the geometrical tracing of the classical orders and their details, the resolution of diverse construction problems, rules of proportion according to ancient and modern authors, and a whole gamut of applications of geometry to architecture. By identifying the history of architecture with the masonic tradition, however, his collection of geometrical opera-



Geometry applied to the design of openings, from Langley's *Builder's Treasury of Designs* (1750).

tions takes on a different meaning. Instead of being mere instruments of technology, geometrical operations assume the character of *poesis*, technical procedures with implicit transcendent objectives. Operational Masonry was practical geometry, a science given by God to the People of Israel, which the Masons of the eighteenth century believed they had inherited. A. M. Ramsay, the "philosopher of Freemasonry," put it this way in 1737: "The Supreme taste for Order, Symmetry and projection could not have been inspired but by the Great Geometrician architect of the Universe whose eternal ideas are the models of true Beauty."[57] Ramsay then went on to describe how God, according to the Holy Scriptures, provided Noah with the proportions of his "floating building" and the manner by which the "mysterious science" had been transmitted, by oral tradition, to Abraham and Joseph, who brought it to Egypt. Masonic science then was disseminated throughout Asia, reached Greece, and, after the Crusades, was brought to Great Britain, the modern center of Freemasonry. Ramsay believed that the Temple of Solomon, which reproduced the proportions of the "primordial tabernacle" of Moses, embodied the laws of the "Invisible World," where all is harmony, order, and proportion.

The great interest of architects in the Temple of Solomon as an archetypal building had grown since the end of the sixteenth century, when the syncretism of the Renaissance began to be questioned and a synthesis of the Graeco-Roman and Judeo-Christian traditions had to be justified rationally. The temple was, in Joseph Rykwert's words, "the image of production as path to salvation," the only monument directly inspired by God still visible on earth.[58] The appreciation of the temple's attributes, however, shifted significantly in the seventeenth and eighteenth centuries. In their late-sixteenth-century reconstruction of the temple, the Jesuits Prado and Villalpando attempted to reconcile the Bible with Vitruvius by postulating that building as the origin of the Corinthian order, while its geometrical plan responded to Renaissance cosmobiology.[59] In his *Entwurff einer Historischen Architectur* (1727), J. B. Fischer von Erlach viewed the temple as an archetypal building, the source of the "great Principles" of Roman architecture, which magically reconciled all differences of taste. But Fischer was not interested in *mathemata*. Instead of its proportions, he praised the grandeur and richness of the mythical building. During the eighteenth century, particularly in the masonic tradition, the temple became an embodiment of the perfect geometrical harmony of the universe and of a meaningful *praxis.*

In *The Builder's Compleat Assistant,* Langley provided his own version of the history of Masonry. After defining geometry as "the most excellent Knowledge of the world, as being the Basis or Foundation of all Trade and on which all arts depend," he described its origins in the Old Testament and its utilization by Hermes, "the Father of Wisdom"; Euclid, "the most worthy Geometrician in the World"; and Hiram, "the chief Conducter of the Temple of Solomon."[60] (The source of this identification of geometry with a mythical building craft was probably a famous manuscript dating from the middle of the fourteenth century, the *Constitutions of the Art of Geometry According to Euclid.*[61])

Langley, it should be noted, concentrated his interest on technical problems, ignoring the metaphysical dimension of architectural theory as a liberal art. This attitude, however, betrayed not a positivistic but a traditional position. Langley's techniques were intended to keep the poetic and symbolic values of medieval craftsmanship, and the result was always fundamentally ambiguous. For as soon as geometry was applied to problems of building construction during the Enlightenment, all the secret or transcendent connotations of Masonic science seemed to vanish. Even when compared to previous seventeenth-century works on statics, stereotomy, and architecture, Langley's collections of technical operations seem neutral, lacking in magic and fascination. Following in the steps of natural philosophy, the mythical framework in Langley's theory became implict, reconciling the respect for traditional myths and proportional systems with a fundamental belief in the continued importance of geometrical operations in architectural history.

The ambiguous uses of geometry by Langley and Morris take on an added significance in view of the fact that British architecture had always disapproved of Italian and Central European Baroque. The formal particularities of architecture, fascinating and irreducible, while being the expression of the most profound personal and cultural characteristics of an architect, should not hinder an understanding of the intentions underlying architecture common to eighteenth-century Europe: an architecture that shared in theory the metaphysical principles of natural philosophy and in practice its transcendent objectives.

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SYMBOLIC GEOMETRY IN FRENCH ARCHITECTURE IN THE LATE EIGHTEENTH CENTURY