

Architecture

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Abstract

During the Renaissance in Europe, between roughly 1300 and 1650, a number of intellectual discourses and practices helped shape the discipline of architecture. This article is not about canonical buildings or the evolution of distinctive stylistic characteristics but rather six key topics within an overall threefold structure: heritage and rupture with the tradition, innovative and original aspects, and impact and legacy. The six topics are geometry as the scientific foundation of architecture; humanism, antiquarianism, and the recovery of ancient architecture; architectural histories and the creation of an *all'antica* architecture; the canonization of the architectural orders; the production of architectural theory; and *disegno* and the use of architectural drawings. Intellectual history, rather than an art history of styles, is the general approach. It begins with a history of the term “Renaissance” and its application to architecture.

“Renaissance Architecture” Versus “Architecture in the Renaissance”

The idea of the Renaissance as a distinct historical period was formulated during its own time. In the fourteenth and fifteenth centuries, humanist authors such as Petrarch (1304–1374) and Flavio Biondo (1392–1463) defined the time in which they lived as separate from the immediate past, the Middle Ages (or *Medium Aevum*). In doing so, these writers confirmed that a new epoch in human history had arrived, one that concerned all matters of human life: from science to literature, from politics to art (Günther 2009; Clarke 2003). For the Italian humanists, this concept of a new era coincided with the idea of a rebirth of the culture of classical antiquity. In the sixteenth century, Giorgio Vasari applied these ideas to the visual arts and referred to this rebirth with the word “rinascita” (Vasari 1550).

The term “Renaissance” itself, however, was introduced only in the nineteenth century, and specifically with reference to art history (Günther 2009). The French art historian Jean-Baptiste Séroux d’Agincourt (1730–1814) used the term in his *Histoire de l’art par les monumens, depuis sa décadence au IV^e siècle jusqu’à son renouvellement au XVI^e* (written from 1789 onward, published between 1810 and 1823). In this work, Séroux d’Agincourt understood the “Renaissance” as the artistic style of a period, which could be historically demarcated. With a focus on architectural history, he dated the

beginning of the Renaissance to the middle of the fifteenth century. In the previous two centuries, he wrote, Italian authors such as Dante, Petrarch, and Boccaccio, along with Greek scholars, had prepared the “triumphant epoch of renewal.” With their work, the human spirit was finally awaking from “its long sleep.” It was only in the fifteenth century, however, that the rediscovery of Vitruvius and the study of ancient ruins revealed the true origins of architecture. Only at this time did the “Renaissance” really begin (Sérour d’Agincourt 1823, III, 86). The period of the Renaissance style in architecture, as understood by him, continued into his own time.

During the nineteenth century, however, art historians revised Sérour’s classification of Renaissance architecture and distinguished Renaissance architecture from Baroque architecture. While Renaissance architecture had previously been distinguished from Gothic architecture through its use of distinct architectural elements (e.g., classical forms, round arches vs. fine tracery, pointed arches), now it was also differentiated from Baroque architecture through the formal conception and arrangement of the same architectural elements (e.g., static vs. dynamic) (Frommel and Bruccleri 2012; Günther 2009; Wöllflin 1915). Within this context, the term “Renaissance” refers more to the formal characteristics of a building than to the historical time period in which the building was built. One can therefore speak of Gothic architecture in France and Renaissance architecture in Italy as being from the same historical moment.

The terms Gothic, Renaissance, and Baroque should thus be understood as modern labels, used to classify and categorize buildings based on stylistic features. There has never been a complete scholarly consensus about the exact definitions of these three terms. Furthermore, the boundary and even distinction between, for example, Gothic and Renaissance architecture has always been a matter of debate. Recently, these very distinctions have received renewed attention within the art historical discipline (Kavaler 2012; Bork 2011; Chatenet 2011).

The debate is related not only to the classification of buildings based on stylistic features, but

also to the possibility of creating a sequential art history founded on a model of historically demarcated period styles. This approach to art history was already formulated in the sixteenth century, as were the doubts surrounding it (Sankovitch 2001). In the first edition of the *Vite de’ più eccellenti pittori, scultori e architettori italiani, da Cimbadue insino a’ tempi nostri* (published in 1550), Giorgio Vasari described the art and architecture of his own time as a progressive evolution, following a natural pattern of birth, growth, maturity, and decline. According to this model, he divided recent and contemporary art into three “manners”: the *prima maniera*, the *seconda maniera*, and the *maniera moderna* (Vasari 1550). In the 1568 edition of the *Vite*, however, Vasari revised this strongly teleological system (Vasari 1568). Different styles and artists could and did operate next to one another.

After its introduction into art history, the term “Renaissance” was taken up outside the discipline. The “Renaissance” was also regarded as a cultural movement, as well as a historical period (e.g., Burckhardt 1860). This widespread appropriation of the term in an interdisciplinary context necessitates its careful and well-defined use. In this entry, “Renaissance” is used specifically to designate the historical period between 1300 and 1650.

Heritage and Rupture with the Tradition

Since antiquity, the standard instruments of the architect had been the straightedge rule and the compass, and this remained largely so during the period under consideration. Geometry was the most important mathematical discipline for architecture, both in theoretical discourse and in design and building practices. Toward the end of the sixteenth century, the dominance of geometry would be challenged when calculation by number entered architectural practice. Architects studied and wrote on geometry and included geometrical rules and formulae in their treatises on architecture; they also made contributions to the field of applied mathematics. By drawing attention to the interconnection between architecture and

geometry, architects also tried to demonstrate the rational basis of their discipline.

During the thirteenth and fourteenth century, admiration for the culture of the ancients steadily grew in Europe – in Italy, France, and Spain in particular. In these places, physical traces of antiquity, whether textual or architectural, had never completely disappeared. Yet from the fourteenth and fifteenth century onward, architects, artists, and humanists changed their approach to these physical remains. Based on the careful study of ancient buildings and written texts, architects started to develop a new architectural language, creating forms that would be used until the twentieth century. Tradition thus became the catalyst for creation and innovation. The study of antiquity also encouraged the historical awareness of architecture as a discipline. Beginning in the fifteenth century, an unprecedented literature on architecture developed, taking the form of written histories, commentaries, and treatises.

Having found in Vitruvius a model, Renaissance authors began to write on architecture in all its aspects. Defining the creation of buildings as a mental practice, these treatises contributed to the concept of architecture as a theoretical and intellectual endeavor. The architectural project, illustrated and communicated in drawings and models, assumed autonomy.

Innovative and Original Aspects

Geometry as the Scientific Foundation of Architecture

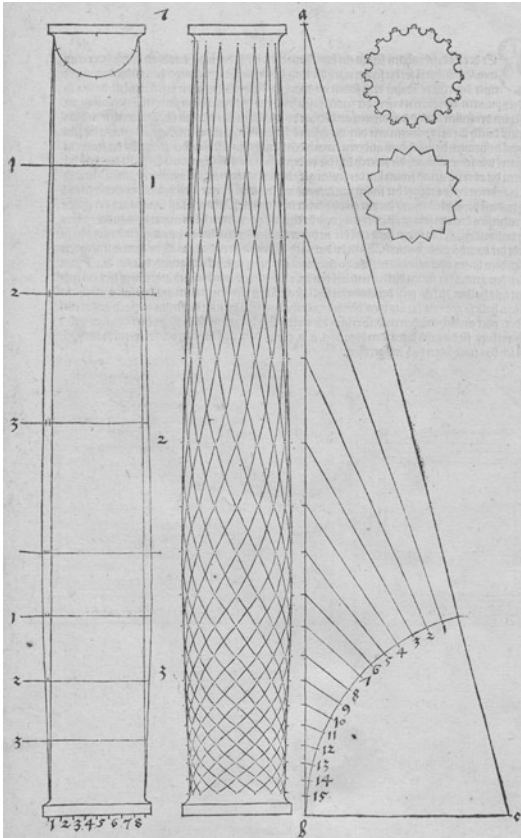
In *De architectura libri decem*, written around 15 BC, Marcus Vitruvius Pollio (c. 80/70–c. 15 BC) argued that architecture is founded in both practice and theory, in *fabrica* and *ratiocinatio*. An architect needs the artisan's knowledge to mold the rough material into a complete building. Architecture is also, however, a rational activity. To perform their profession well, architects should study all the liberal arts (Pauwels 2012; Evers and Thoenes 2003; Payne 1999). Yet among the liberal arts, Vitruvius privileged mathematics, and specifically

geometry, as fundamental to architecture (Pauwels 2012).

This close connection between architecture and geometry continued during the Middle Ages and was expanded on between 1300 and 1650. Antonio Averlino (c.1400–c.1469), better known as Filarete, defined architecture, in his *Libro architetonico* (c. 1461–1464), as comprising measurement and proportion. Albrecht Dürer (1471–1529) applied the principles of geometry to architecture, engineering, and typography in the third book of *Underweysung der Messung mit dem Zirckel und Richtscheit*, published in 1525. In his *Premier tome de l'architecture*, published in 1567, Philibert de L'Orme (1514–1570) stressed the importance of geometrical knowledge for stereometry – that is, the science of measuring the volume of solid objects (Figs. 1 and 2).

Collaborations between mathematicians and architects also led to advancements in both fields (Günther 2009). Filippo Brunelleschi (1337–1446) was acquainted with the mathematician Giovanni dell'Abbaco (1354/1371–c. 1440), who most probably advised him in developing the revolutionary construction technique for the cupola of Santa Maria del Fiore in Florence. Furthermore, at the beginning of the fifteenth century, there was a growing desire to grasp the visual world, to depict what is seen in a mimetic way, among a group of artists in Florence. In this context, Filippo Brunelleschi studied the geometrical structure of the conical pyramid, the laws of which had been identified by Roger Bacon around 1260–1270. This enabled him to identify linear perspective and illustrate it in two panels (now lost) (Trachtenberg 2010; Günther 2009). This identification of linear perspective further revolutionized the way in which architectural structures could be represented on a two-dimensional surface.

The relation between geometry and architecture also extended to a more metaphysical level (Evers and Thoenes 2003). Plato's geometry was one of the most important models of the universe, handed down from antiquity through the Middle Ages via a late ancient Latin translation of the *Timaeus*. According to Plato's cosmology, a



Architecture, Fig. 1 Illustrating the construction of a column through geometrical principles. (Albrecht Dürer. 1538. *Underweysung der Messung, mit dem Zirckel und richtscheyt, in Linien, Ebnen und gantzen Corporen*. [Nürnberg]: [Formschneider]. 90. doi: 10.3931/e-rara-8271. ETH-Bibliothek Zürich, Alte und Seltene Drucke)

creator had used mathematical laws to transform the world from a state of chaos to a state of order. This resulted in a universal harmony, in which each part was in proportion to the others and to a larger whole. Pythagorean number theory further showed that numbers pervaded every part of the universe. Their strong reciprocal relations seemed to bind the universe together in a state of stability (Hiscock 2007).

In certain cases, the relationship between measurement, proportion, and universal harmony was made explicit in literature dealing with architecture. In *De re aedificatoria* (written between 1443 and 1452, first published in 1485) Leon Battista Alberti (1404–1472) based his proportional

system on musical proportions. Luca Pacioli (c. 1445–1517) included architectural topics in his *De divina proportione* (composed around 1498, first printed in 1509). In Milan, Pacioli collaborated with Leonardo da Vinci (1452–1519), who drew the polyhedra for *De divina proportione*.

Both on the building site and in making drawings on paper, geometry was fundamental to architecture (Bork 2011; Trachtenberg 2010). During the sixteenth century, however, architects also started to calculate with numbers. At this time, modern numeracy spread rapidly across Europe in all domains of life (Carpo 2003). Giacomo Barozzi da Vignola (1507–1573) inserted proportional measurements, written in Hindu-Arabic numbers, in the images of his *Regola delli cinque ordini d'architettura* (c. 1562–1563). Andrea Palladio (1508–1580) applied the same technique in his *Quattro libri dell'architettura* (1570). The adoption of this new system in architecture seemed rather slow. In certain cases, calculation by number was met with outright hostility. As late as 1641, Carlo Cesare Osio (b. 1612) published *Architettura civile*, in which he attempted to return architecture to a state of pure geometry, without the use of numbers (Carpo 2003; Fig. 3).

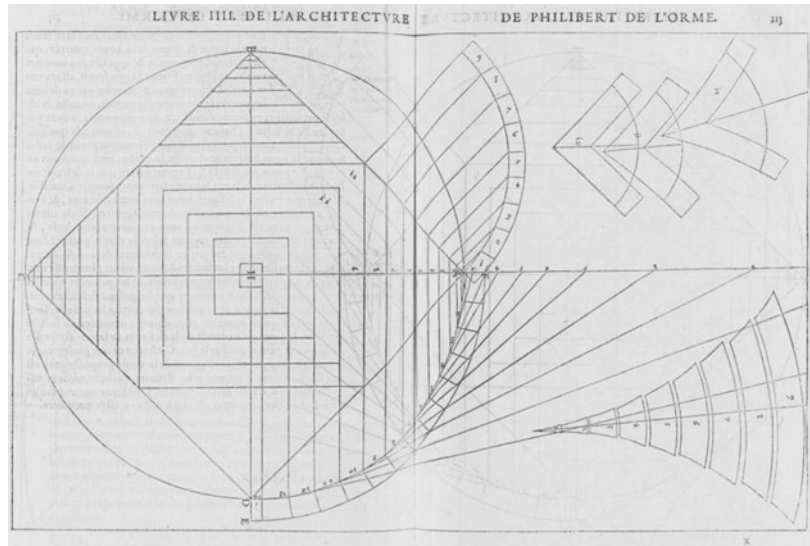
Humanism, Antiquarianism, and the Recovery of Ancient Architecture

Although admiration for ancient culture had steadily grown from the thirteenth century onward, the study of ancient architecture and the creation of *all'antica* architectural forms – that is, those in the ancient manner, specifically of the Romans – began only in the fifteenth century. This study of ancient architecture took place on both a textual and archaeological level. The process of discovery, moreover, was a joint endeavor, as humanists, writers, artists, and architects all collaborated in this study of the ancient past (Günther 2009; Clarke 2003; Payne 1999; Smith 1992).

A central text in this process was Vitruvius' *De architectura libri decem*. Under the influence of Italian humanism, this treatise gained renewed attention at the beginning of the fifteenth century.

Architecture,

Fig. 2 Principles of stereometry for the construction of a spherical vault (Philibert De l'Orme. 1567. *Le premier tome de l'architecture*. Paris: chez Federic Morel. Book IV, 113. doi: 10.3931/e-rara-15,161. Universitätsbibliothek Bern)



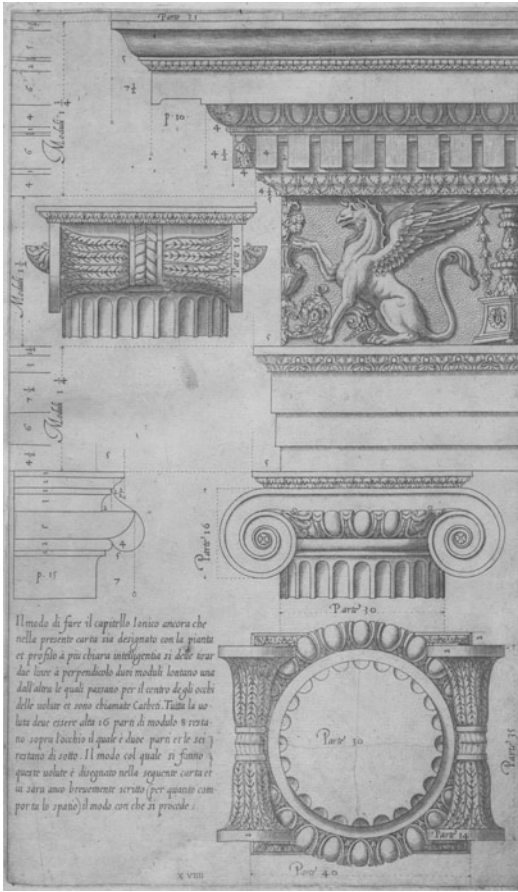
Using a new philological approach to ancient texts, Italian humanists critically edited and translated the manuscripts they found in monastic libraries. In this context, Poggio Bracciolini (1380–1459) “rediscovered” Vitruvius’ treatise in 1414 at the Abbey of St. Gallen in Switzerland (Günther 2009; Clarke 2003; Payne 1999).

In the fifteenth century, Vitruvius’ treatise attracted the attention of both humanists such as Leon Battista Alberti and architects such as Lorenzo Ghiberti (1378–1455), Filarete, and Francesco di Giorgio Martini (1439–1502). But given the state of the treatise – which was incomplete, often unclear in its descriptions, and written in a combination of highly technical Latin and Greek – humanist scholars were better equipped to read and interpret the text. Furthermore, the images that originally accompanied the texts were lost (Günther 2009; Clarke 2003; Payne 1999).

Fifteenth-century enthusiasm for Vitruvius’ work was due not only to its renown as a text recovered from antiquity but also to its potential to grant authority to contemporaries to discuss a wide variety of relevant architectural topics. As an extensive, ten-book treatise, it included such topics as the visual representation of buildings, construction techniques, proportion systems, the proper design of building types, as well as ornamental features. By the second half of the fifteenth

century, Vitruvius’ text also increasingly served as the model for new writings on architecture, as will be discussed later. Although architects often disagreed about the accuracy of Vitruvius’ pronouncements, the ancient treatise was indisputably effective as an expository model. It showed that architecture was an intellectual discipline and a topic worthy of theoretical reflection.

By the mid-fifteenth-century, patrons and scholars all over Italy, as well as ecclesiastical librarians, copied and owned manuscripts of the treatise (Clarke 2003). From the 1470s onward, this study and interpretation of *De architectura* intensified. In 1486, the *editio princeps* was published under the supervision of Giovanni Sulpizio da Veroli (fl. c. 1470–1490). In 1511, Fra Giovanni Giocondo da Verona (1433–1515) printed the first illustrated edition in Venice. Ten years later, the first Italian translation by Cesare Cesariano (1476/1478–1543) was published in Como. Another authoritative Italian edition was published in 1556, with a commentary by Daniele Barbaro (1514–1570) and illustrations by Andrea Palladio. From the sixteenth century onward, the treatise became available in other European languages. In 1547, a French edition by Jean Martin (d. 1553), with illustrations by Jean Goujon (c. 1515–1564/1568), was published in Paris. One year later, Walther Ryff (c. 1500–1548) brought out the first German edition. In 1582, a



Architecture, Fig. 3 The introduction of fractures with Hindu-Arabic numerals to illustrate the construction of the ionic capital. (Giacomo Barozzi da Vignola. 1607. *Regola dell' cinque ordini d'architettura*. Rome: Andreas Vaccarius. 43. doi: 10.3931/e-rara-9949. ETH-Bibliothek Zürich, Alte und Seltene Drucke)

Spanish edition followed (Evers and Thoenes 2003; Payne 1999; Figs. 4 and 5).

While Vitruvius' *De architectura libri decem* was an important written source on ancient architecture, it was not the only text humanists and architects consulted. Pliny the Elder's *Natural History* (written in the first century AD), for example, was studied widely by humanists, artists, and architects for his detailed descriptions of ancient architectural wonders, as well as his elaborations on construction materials and ornamental features (Fane-Saunders 2016).

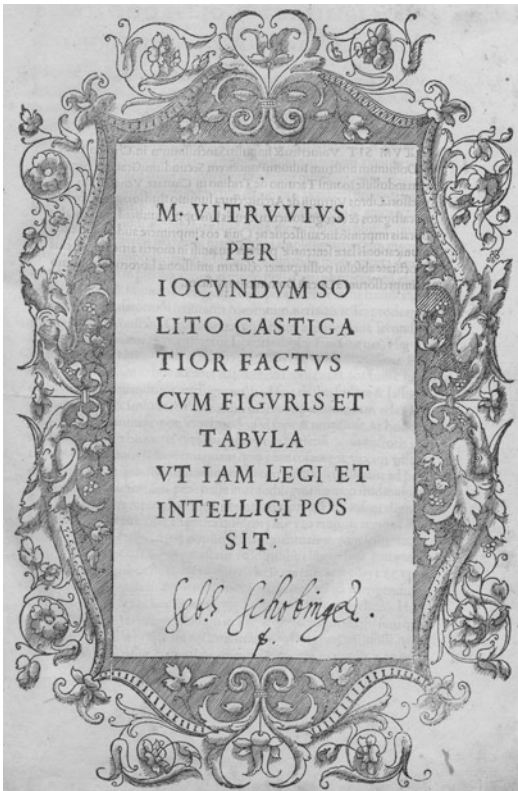
In addition to textual analysis, humanists and architects studied ruins to recover knowledge of

ancient architecture. In the fifteenth century, humanists started to collect and record ancient inscriptions. They tried to classify ruins historically, as well as to identify the location of buildings they read about in ancient texts. Their detailed studies resulted in descriptions of ancient Rome, including *De varietate fortunae* by Poggio Bracciolini and *Roma instaurata* by Flavio Biondo (1392–1463). Architects, on the other hand, focused on the architectural characteristics of the fragments, such as their structural composition and ornamental features. In many cases, however, the pursuits of humanists and architects intersected (Günther 2009; Clarke 2003). In his famous letter to Leo X (1475–1521; r. 1513–1521), for example, Raphael (1483–1520) encouraged the pope to preserve, measure, and draw the buildings of ancient Rome. In the end, the final goal was the revival of ancient architecture and its realization in contemporary practice (Sankovitch 2001; Nagel and Wood 2005).

Studies of ancient fragments of columns, capitals, bases, and cornices, surviving in ruins or as *spolia*, were documented on paper. Continuously copied, these images facilitated the wide dissemination of knowledge about ancient fragments, communicating different types of information from what was contained in written texts. The attention to clear and precise measurement and representation in these drawings varied greatly. While some studies tried to be as exact as possible in terms of the measurements and forms they represented, others took on a more imaginative aspect. With the advent of the printing press, single-sheet engravings further disseminated the wide variety of ornamental possibilities (Waters 2012).

Architectural Histories and the Diversity of all'antica Architecture

Along with the study of ancient buildings through texts and ruins, the idea that architecture was a discipline with its own history began to take form (Günther 2009). In Italy, this history of architecture was conceptualized and written down by numerous authors, each of whom adopted his own approach. Alberti, for example, saw the



Architecture, Fig. 4 Title page of Fra Giocondo's illustrated edition of Vitruvius's *Architectura Libri Decem*. (Giovanni Giocondo. 1511. *M. Vitruvius per locundum solito castigior factus...* Venice: Tacuino. Title page. doi: 10.3931/e-rara-19,439. Stiftung Bibliothek Werner Oechslin)

origins of the art of building in Greek culture. The Greeks had recognized that architecture was based on rules and had applied these rules in their buildings. The Romans, Alberti argued, had then developed this art of building to its fullest potential (Alberti 1988). But despite differences between Alberti's history and the histories put forward by Antonio Manetti (1423–1497) and Giorgio Vasari, for example, the main narratives assumed by early modern architectural historians were usually the same. They generally agreed that good architecture had flourished under the Romans. How long it continued to flourish, however, was a matter of controversy. Most thought until the reign of Constantine (c. 305–337), but some extended it further. Nevertheless, everyone held that the invasion of the Germanic tribes in Italy

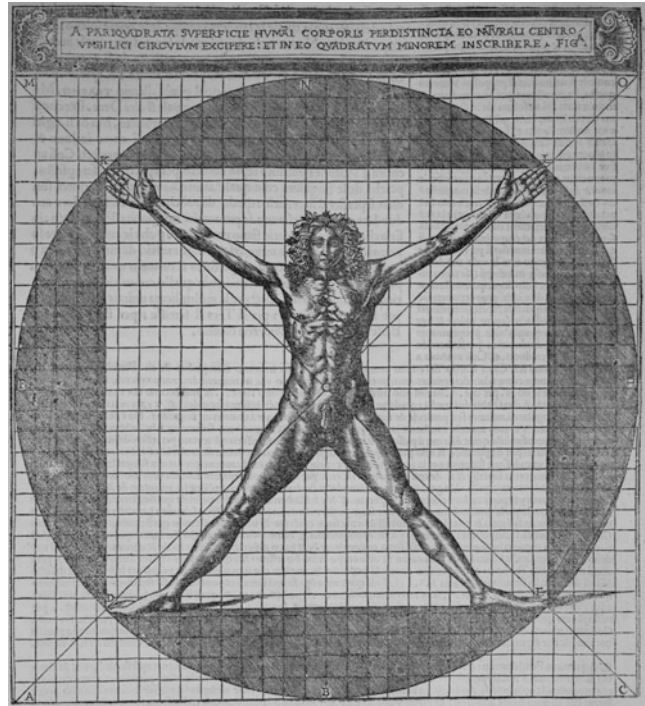
(fifth to eighth century) had marked the end of good architecture, as well as the necessary knowledge of construction. Only when Charlemagne liberated the Italians from German rule in the eighth century was the art of building slowly but surely restored (Günther 2009; Sankovitch 2001).

While the architectural forms imported under German rule were harshly criticized in Italy, the notions “Gothic,” “German,” and “modern” were neither uniform nor clearly defined. Likewise, authors applied the word “modern” differently. Filarete begged his contemporaries to abandon “modern usage,” for “only barbaric people could have brought it into Italy” (Filarete 1965). Vasari stated that the ancient and modern manner (*maniera dell'antica e moderna*) was “virile, solid and simple.” The German manner (*maniera tedesca*), on the other hand, was “monstrous and barbarous,” “with columns that are thin and twisted like vines and do not have the strength to bear a load, no matter how light” (Sankovitch 2001; Vasari 1568). Not all Italians criticized this foreign method of design. Occasionally, expressions of enthusiasm and admiration for German architecture appear. Pope Pius II (1405–1464) even ordered that the cathedral in Pienza be built on the model of the German Hallenkirche (c. 1459–1464).

On the other side of the Alps, the French similarly established their own definition of good architecture. Here, the adoption of Italian architectural forms was initially (and, in a certain sense, would continue to be) met with suspicion. French architects and theorists stressed the boldness and lightness of their own architectural structures, testing the architectural references they employed against these characteristics; for example, French theorists often presented Hagia Sophia, rather than the Pantheon, as an example of good architecture (Günther 2009).

In their recovery of true architecture (constructed in Roman times and since the liberation from German rule), Italian architects viewed both ancient and local Romanesque buildings as models for contemporary practice. This is because, on the one hand, it was not yet possible to differentiate an antique from a Romanesque building based on stylistic characteristics. When

Architecture, Fig. 5 The Vitruvian Man in Cesare Cesariano's illustrated and Italian edition of Vitruvius's treatise (Cesare Cesariano. 1521. *Di Lucio Vitruvio Pollione de architectura libri dece*. Como: Gotardus de Ponte. Book III, Ll.r. doi: 10.3931/e-rara-19,393. Stiftung Bibliothek Werner Oechslin)



the exact date of a building was in doubt, historical, iconographic, or technical arguments rather than stylistic characteristics were used (Clarke 2003, Smith 1992). On the other hand, even when it was known that a building was constructed during the Middle Ages, it could still serve as a model because it was seen as the result of ancient tradition (Nagel and Wood 2005; Clarke 2003). Brunelleschi thus studied both the Pantheon in Rome (c. 118–128) and the church of San Miniato al Monte in Florence (c. 1018–1062) as exemplary architectural models.

This emphasis on local traditions, together with traditional building practices (material, techniques, and so on) gave rise to a variety of *all'antica* forms in Europe, even within Italy. In Venice, the adoption of Byzantine elements emphasized the cosmopolitan character of the city. In Bologna, the traditional use of terracotta gave the city its specific red color. In Florence, the geometrical patterns of the façades of the cathedral baptistery and the church of San Miniato al Monte inspired architects to use various colored marbles. But in the sixteenth century, with the canonization of the architectural orders, a certain

standardization and unification of *all'antica* forms began to take shape throughout Italy and beyond.

The Canonization of the Architectural Orders

By the beginning of the sixteenth century, as the study of Vitruvius and of ancient ruins progressed, the discrepancies between them became ever more obvious. In Rome, architects began to classify, systematize, and ultimately canonize ancient fragments. The contributions of Donato Bramante (1444–1514), Raphael, Baldassare Peruzzi (1481–1536), and Antonio da Sangallo the Younger (1485–1546) gave rise to the concept of the architectural orders (Waters 2012; Payne 1999; Thoenes and Günther 1985). In the formulation of the architectural orders, the constituent parts, the ornament, and proportions of the columnar system were systematically defined. In the illustrated edition of Vitruvius' *De architectura*, Cesare Cesariano represented individual columns with their ornamental features on a single page.

Architectural treatises contributed to the codification of the architectural orders. Sebastiano Serlio (1475–1553/1555) wrote several books on architecture, published in Venice, Paris, and Lyon,

between 1537 and 1575 (Evers and Thoenes 2003; Payne 1999). In 1619, all these books were assembled and printed in Venice under the title *Tutte l'opere d'architettura et prospettiva di Sebastiano Serlio bolognese*. Book IV, *Regole generali di architettura sopra le cinque maniere degli edifici*, printed in Venice in 1537, was the first systematic treatment of the five architectural orders (*maniere*) in a printed work. Based on his study of Vitruvius, ancient ruins, and contemporary practice, Serlio organized the orders into five coherent systems: Doric, Ionic, Corinthian, Tuscan, and Composite (Fig. 6). In Book VII of *Le premier tome de l'architecture*, printed in Paris in 1567, Philibert de l'Orme added a sixth architectural order to Serlio's "cinque maniere" (Evers and Thoenes 2003): the French order. De l'Orme's invention is a precursor to the vehement seventeenth-century debates about the existence of a typical French order.

Giacomo Barozzi da Vignola's introduced the term "order" in his *Regola delli cinque ordini d'architettura*, first printed in Rome in 1562 (Fig. 7). Appearing in more than 250 editions, Vignola's *Regola delli cinque ordini* was the most authoritative text on the architectural orders until the beginning of the twentieth century (Evers and Thoenes 2003; Carpo 2003). Printed with copper plates, the illustrations took center stage, with the text reduced to the minimum. Concerning proportion in the architectural orders, Vignola's contribution was to deduct the standard module from the building's height, using modern methods of calculation; previous authors had mainly worked up from the diameter of the column using geometrical procedures.

Building and Writing: The Textual Production on Architecture

The architectural orders, however, were just one out of many topics addressed in architectural treatises, a literary genre in which architecture itself was the main topic of discussion. The form, content, length, language, and use of images could vary greatly in such treatises, as did the readership addressed – from patrons and humanists to fellow architects and craftsmen. As written texts (whether illustrated or not), they created both a

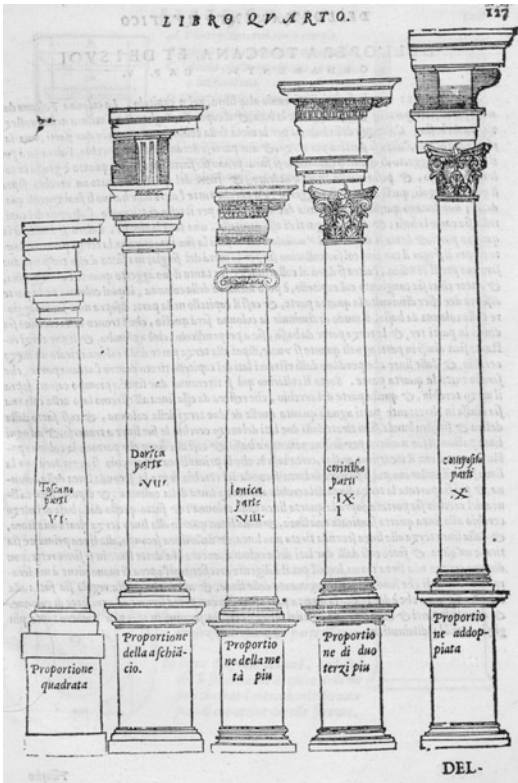
theoretical framework and a language with which to discuss architecture. The production of architectural treatises was closely connected with the position of architects in society and their attempt to ennoble the profession. The goal of such treatises was to differentiate architects from artisans, as well as to associate architecture with the liberal rather than the mechanical arts.

Alberti's *De re aedificatoria* is generally considered to be the first architectural treatise of the Renaissance (Evers and Thoenes 2003; Payne 1999; Alberti 1988). Written in Latin between 1442 and 1452, and without illustrations, Alberti presents his theory of architecture based on his personal study of Vitruvius and of ancient ruins. With its attempt to establish the rules of architecture and to prove its rational basis, the treatise addressed a learned readership rather than practicing architects. The treatise was immediately received as an authoritative text (Fig. 8).

Between 1461 and 1464, Filarete produced his *Libro architetonico* (Evers and Thoenes 2003; Filarete 1965). Using the dialogue format, Filarete handles three topics: the general outline of his architectural theory, the planning and construction of the fictional city of Sforzinda, and the description of real and imaginary ancient buildings. Written in Italian and partially illustrated, the treatise addressed a different readership from *De re aedificatoria*. Although the autograph version of the text has been lost, a number of manuscript copies, such as the Sforza group (Codex Trivulzianus, Codex Palatinus) and the Medici group (Codex Magliabechiano, Codex Valencianus), still survive.

Francesco di Giorgio Martini wrote his *Trattato di architettura* between 1475 and 1495 (Merrill 2013; Evers and Thoenes 2003; Payne 1999). Like Filarete's treatise, it was written in Italian and fully illustrated. In it, Francesco di Giorgio defined architecture as a scientific discipline, founded on arithmetic and geometry. Although the treatise remained unpublished, it was reproduced in hundreds of manuscripts and became a standard reference work in Italy by the end of the fifteenth century.

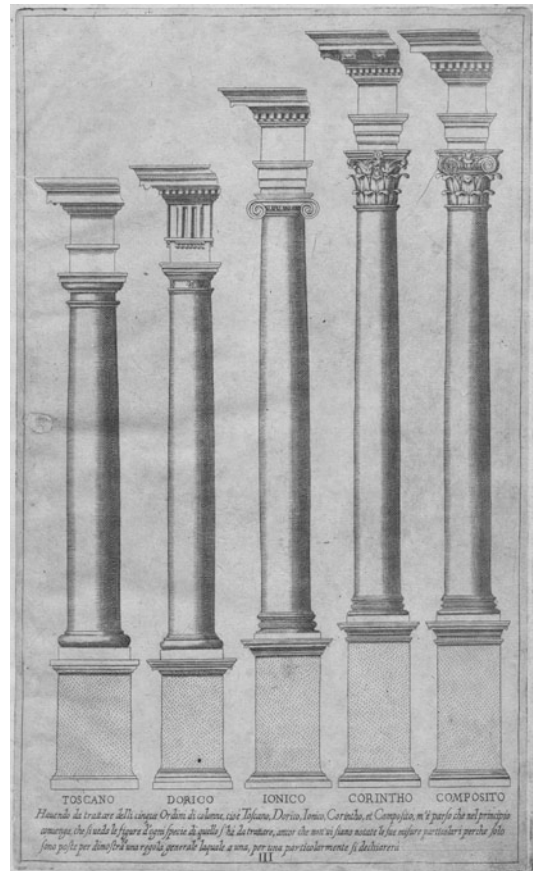
The production of architectural treatises intensified in the following century. The many authors



Architecture, Fig. 6 The five ways (*maniere*) of building by Sebastiano Serlio. (Sebastiano Serlio. [1584]. *Tutte l'opere d'architettura di Sebastiano Serlio*. Venice: apresso Francesco de'Franceschi. Book IV, 127r. doi: 10.3931/e-rara-26,987. ETH-Bibliothek Zürich, Alte und Seltene Drucke)

include Sebastiano Serlio, Giacomo Barozzi da Vignola, Pietro Cataneo (c.1510–c.1571), Andrea Palladio and Vincenzo Scamozzi (1548–1616) in Italy; Philibert de l'Orme and Jacques Androuet du Cerceau (c.1521–c. 1568) in France; Diego de Sagredo (first half of the sixteenth century) and Juan Bautista Villalpando (1552–1608) in Spain; John Shute (d. 1563) and Henry Wotton (1568–1639) in England; and Albrecht Dürer, Hans Blum (b. c. 1520/1530) and Hans Vredeman de Vries (1526–1609) in Germany and Northern Europe.

Vincenzo Scamozzi's *L'idea dell'architettura universale*, printed in 1615, can be considered as the last treatise of the Renaissance in which architecture is portrayed as a universal science encompassing all domains of life (Evers and



Architecture, Fig. 7 The five orders of the columns by Iacomo Barozzi da Vignola (Giacomo Barozzi da Vignola. 1607. *Regola delli cinque ordini d'architettura*. Rome: Andreas Vaccarius. 11. doi: 10.3931/e-rara-9949. ETH-Bibliothek Zürich, Alte und Seltene Drucke)

Thoenes 2003; Payne 1999). As with many of his ideas, he turned to Neoplatonism to justify this claim. According to this philosophy, God had created a mathematically and geometrically ordered cosmos, in which each element was related to every other one as well as to the larger whole. Created in the image of God, the human body and its proportions gave access to these universal laws and rules of the universe. The ideal proportions for architecture could thus be found in the human body. Despite Scamozzi's attempt to write a universal theory of architecture, it was Book VI, on the architectural orders, that had the most lasting influence; from 1657 onward, it also appeared separately, in a shortened version.



Architecture, Fig. 8 Title page of the Italian translation of Alberti's *De re aedificatoria*. (Leon Battista Alberti. 1550. *L'architettura di Leonbatista Alberti*. Florence: appresso Lorenzo Torrentino. Title page. doi: 10.3931/e-rara-770. ETH-Bibliothek Zürich, Alte und Seltene Drucke)

Although these architectural treatises are presented here, for reasons of clarity, as isolated works, they often complemented a wider *oeuvre* of writings by the same author. Alberti wrote *De re aedificatoria* after the publication of his *De pictura* (1435, in Italian 1436), *De statua* (date unknown), and many other works. Cataneo wrote both a treatise on architecture (*I quattro primi libri di architettura*, 1554) and another on applied geometry (*Pratiche delle due prime mathematiche*, 1559), and Dürer wrote treatises on the application of geometry to architecture (*Underweysung der Messung mit dem Zirckel und Richtscheit*, 1525), military architecture (*Etliche underricht, zu befestigung der Stett, Schloss, und flecken*, 1527), and human

proportion (*Vier Bücher von menschlicher Proportion*, published posthumously, 1528). Furthermore, the architectural treatise was merely one of the genres in which topics related to architecture were discussed. From the second half of the fifteenth century, written and drawn studies of machines, ancient fragments, military devices, human bodies, and geometrical patterns proliferated, all of which testify to the wide cultural field in which architecture was involved at the time. Biblical exegesis, military science, and discourses on agriculture, among others, influenced ideas and precepts about building typologies and established a variety of interconnections between building theory and practice.

Design as a Mental Practice and the Use of Architectural Drawings

The use of drawings in architectural design processes has a long history. The ancient Egyptians, Greeks, and Romans most likely employed drawings in planning their pyramids and temples. The same assumption applies to the builders of the early Middle Ages. From the thirteenth and fourteenth century onward, the use of drawings in the design process is well documented. The surviving drawings mostly relate to the design of the complex stone structures of monumental churches and cathedrals (Bork 2011; Hubert 2005). The earliest of these are of French origin (Villard Honnecourt's Sketchbook, c. 1235 and the Reims Palimpsest, 1240–1260) (Bork 2011). Parallel with this corpus of design drawings, the professional definition of the architect as a skilled craftsman underwent considerable change. To design through drawing became the architect's specialized skill (Hubert 2005).

The corpus of surviving architectural drawings increases considerably from the fifteenth century onward. This is, in part, explained by technological achievements. During the Middle Ages, drawing was often ephemeral, completed either on mobile supports, such as parchment or wooden tablets which could be erased and reused, or on the building surface itself (Bork 2011; Günther 2009; Hubert 2005). Although paper had been produced in Europe since the twelfth century, it only became widely available in the fifteenth century. As a

cheaper alternative to parchment, and as a long-lasting material support, paper offered great potential for architects. Its portability also allowed the wide dissemination of drawings, increasing communication on and transmission of design concepts. By the sixteenth century, paper was the material support of choice for the design of new structures, as well as for the documentation of ancient ruins, anatomical studies, and multiple forms of graphic experimentation. Bramante's designs for St. Peter's in Rome are among the first design drawings on paper that are still extant (from 1505 to 1506) (Günther 2009; Hubert 2005).

At the same time that paper became increasingly available, the study of Vitruvius, the discovery of linear perspective, and the learned discourses in architectural treatises together encouraged theoretical reflection on and discussion of architectural representation (Hubert 2005). This development was also related to the study and documentation of ancient ruins. In the fifteenth and sixteenth centuries, architects devised new representational techniques to document buildings completely and objectively (Günther 2009; Clarke 2003; Payne 1999). Raphael proposed one such system of graphic codification in his letter to Leo X. By means of the orthogonal projections of the plan, elevation, and section, he would document the (for the most part) lost buildings of ancient Rome.

Theoretical reflections in Italy were also concerned with the role of drawing in the architect's creative process (Caye 2008/09). In his *De re aedificatoria*, Alberti described the architect's design process as a mental activity. According to him, the architect should conceive the building in his mind before construction and entirely abstracted from any material form. Drawings and three-dimensional models are the means by which this mental image takes visual, tangible form (Trachtenberg 2010; Caye 2008/09; Alberti 1988). In his *Libro architetonico*, Filarete described the steps by which the mental image is translated into physical reality: from initial drafts, followed by more detailed sketches, to plans in scale, and finally the architectural model (Caye 2008/09; Filarete 1965). Between the

architectural projects conceived in the artist's mind and the actual built structure, therefore, stood the architectural drawing and the model (Caye 2008/09, Millon and Lampugnani 1994).

Such discussions about the use of drawings in the creative process were related to cognitive psychology. In *Metaphysics*, Aristotle had formulated the idea that the outline of a creation preexists in the artist's mind before being transformed into matter (Caye 2008/09). Beginning in the fifteenth century, theorizing about this process and about related concepts (e.g., *ingenium*, *inventio*, and *disegno*) took on an ever growing importance, not only in painting and sculpture but also in architecture. A central figure was again Vasari. He understood *disegno* as an intellectual construct based on judgement and expressed through the work of the hand; *disegno* was understood as "a word of the mind as much as a word of the hand" (Didi-Huberman 2005: 78). In 1563, the academy of the *Arti del disegno* was established in Florence. For the first time, the three arts of *disegno* (architecture, sculpture, and painting) were brought together in an institutional setting.

Impact and Legacy

The study of ancient fragments and texts, together with scientific and graphical experiments, led to the introduction of a new formal language in architecture. The architectural orders were not only codified and transmitted by a wide variety of textual and graphical means, they also became the defining constitutive elements of architectural design for at least four centuries. While the twentieth century saw a profound change in the formal language of architecture, the means to create form largely remained the same as in the Renaissance. Architects still used pencil and paper to translate architectural ideas into visual form. Plans, sections, and elevations, using the orthogonal projection, as well as perspectival drawings and models, continued to be the general formats for designing and communicating architectural ideas. It was not until the 1960s and 1970s, with the emergence of digital means, that design and communication instruments experienced a new revolution. The

Renaissance also witnessed the rise of ideal cities, the first notions of landscape design, and the development of distinct building typologies. It produced thorough discussions of the social and political importance of architecture, as well as its ethical implications. The design of machines, as well as military devices and structures, very often belonged to the architect's portfolio. Such topics have not been addressed here, but they contributed, together with the six themes discussed, to the development of the architectural discipline during the Renaissance.

Cross-References

- Academies
- Albrecht Dürer
- Antiquarianism
- Architect
- Artefact
- Artisan
- Artist
- Arts, Visual
- Beauty
- Cities and Urban Life
- Dante Alighieri
- Engineer
- Erwin Panofsky
- Filarete
- Francesco Petrarca
- Giorgio Vasari
- Giovanni Boccaccio
- Harmony
- Humanism
- Imagination
- Interpretations of Renaissance
- Intellect
- Invention
- Jacob Burckhardt
- Leonardo Bruni
- Leon Battista Alberti
- Leonardo da Vinci
- Luca Pacioli
- Neoplatonism
- Optics
- Perspective
- Practical Knowledge
- Printing and Publishing
- Printing Technique
- Scientia
- Sculpture
- Studia humanitatis
- Style
- Textbook
- Treatise
- Vitruvius and the Classical Orders

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