14. The *Timaeus*, Perspective, and Early Renaissance Concepts of Architectural Space

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Abstract

The reception of Plato's *Timaeus* during the Renaissance coincided with ground-breaking developments in the conceptualisation and design of architectural space and the 'invention' of pictorial space. This coincidence gave rise to fertile areas of influence of Platonic principles on artistic and architectural creativity, which drew closely on the Timaean commentary tradition through the intellectual exchanges of humanists, artists, and architects. This chapter explores the influence of Plato's cosmological accounts in the *Timaeus* on architectural and pictorial ideas in fifteenth-century Florence. This was revealed by a combination of harmonic proportional systems in architecture, conceived through imagined, mental constructs that pictured buildings as 'cosmological receptacles', and the creation of projective, illusory space in perspective that consciously drew alignments between the vantage point of the human observer and the infinitude of divine vision. A key figure in the early Renaissance who cultivated these connections between architecture, perspective, and Timaean principles was Leon Battista Alberti whose treatises on painting and architecture laid the theoretical foundations for the development of Renaissance ideas of Platonic 'space'. The chapter examines Alberti's writings in the light of influences of other key figures in fifteenth-century Florence such as Filippo Brunelleschi, Ambrogio Traversari and Marsilio Ficino.

1 Introduction

To understand the importance of Plato's *Timaeus* in the shaping of ideas in architecture and the visual arts during the Early Renaissance, it is first necessary to consider briefly the intellectual background in which Platonic philosophy flourished within humanist circles. The impact of Platonism on Humanism, from the beginning of the fifteenth century, has been the subject of intense debate among philosophers and Renaissance scholars, in particular whether Humanism can be considered a philosophy, or a philosophically inspired movement.[1] In this study, I do not intend to revisit these debates, but rather to situate the *Timaeus* within the broader cultural milieu of fifteenth-century Humanism, thereby providing a framework for determining its possible architectural and artistic manifestations.[2]

An important factor in this enquiry concerns the availability of textual sources, in the form of translations and commentaries of the *Timaeus,* and their reception within humanistic and theological circles. How did knowledge of the *Timaeus,* among members of the clergy and scholars in Florentine society, percolate down to artistic circles through informal exchanges? Through this dissemination of Plato's philosophy, the study will seek to demonstrate how the *Timaeus* influenced the development of architecture as a discipline and a creative process. Accordingly, the investigation will consider how Timaean principles of number and geometry informed the canons of architecture, and the form and symbolism of buildings and urban spaces. The final part of the chapter will examine the possible contributions of the *Timaeus* to developments in pictorial space, or the codification of linear perspective. A key figure in this chapter will be Leon Battista Alberti, whose treatises on architecture (*De Re Aedificatoria*) and painting (*De Pictura*) played a pivotal role in

[1] For an account of the background to the dispute see Ernesto Grassi, *Heidegger and the Question of Renaissance Humanism* (Binghampton, NY: State University of New York, 1983).
[2] This relationship centres on the notion of 'civic humanism' in the Early Renaissance (H. Baron, *Crisis of the Early Italian Renaissance*, 1955), when humanism possessed a broader civic/public dimension before its reduction to a learned curriculum (*Studia Humanitatis*) during the late 15th and early 16th centuries..

articulating spatial, linguistic, and symbolic analogies which I shall argue were influenced by the *Timaeus*.

2 Reception of the *Timaeus* and Calcidius' Commentary

Surviving manuscripts of Calcidius' translation of the first part of the *Timaeus* and his *Commentary* had been in circulation since the early Middle Ages, but two periods represent the most productive in the revival of Timaean studies since antiquity: 1125-1225 in Chartres and 1425-1475 in Florence.[3] The second phase, the focus of this study, coincided with the design and construction of the dome of Florence Cathedral by Filippo Brunelleschi and other related projects.

The Early Renaissance witnessed important developments in the cultivation of relationships between scholarly enquiry, architectural and artistic activities, partly because humanists were more engaged with artistic work than their 'scholastic' counterparts in the Middle Ages. As Richard Krautheimer has observed: 'Art became permeated with the concepts and vocabulary of humanism; it became part of humanist endeavour. Concomitantly, the humanists turned art into a problem of their own.'[4] This cross-fertilisation between intellectual enquiry and artistic activity was thanks in part to the new humanistic environment that extended across many aspects of urban life, where merchants, artists, architects and scientists learned about classical principles, supported by libraries and private collections in Florence and elsewhere. First-hand knowledge of the contents of the *Timaeus*

[3] Paul Edward Dutton, 'Material Remains of the Study of the *Timaeus* in the Later Middle Ages', in Claude Lafleur (ed.), with Joanne Carrier, *L'enseignement de la philosophie au XIII^e siècle: Autour du 'Guide de l'étudiant' du ms. Ripoll 109: actes du colloque international*, Studia Artistarum, 5 (Turnhout: Brepols, 1997), 203-30, at 204-5.
[4] Richard Krautheimer, with Trude Krautheimer-Hess, *Lorenzo Ghiberti* (Princeton, New Jersey: Princeton University Press, 1956, reprinted 1990), 300.

and Calcidius' commentary, among artists and architects, would have been limited not least because most practitioners in the visual arts and crafts were not versed in Latin or Greek and therefore relied on second-hand sources and translations in the Italian vernaculars.[5] A key source in the dissemination of Platonic and Pythagorean principles in artistic and architectural circles was Vitruvius. There are, however, exceptions to this reliance on 'second-hand' sources. Above all, Alberti, humanist, papal secretary and later architect, wrote the first architectural treatise since antiquity in Latin, which contained numerous references to Timaean principles, and the artist Lorenzo Ghiberti had a working knowledge of Latin and an interest in Platonism demonstrated in his famous unfinished treatise, *I Commentarii*.[6]

A further factor to be considered is the status of architecture and the visual arts in the Renaissance, when compared with the earlier Middle Ages. This centred on the relationship between manual labour and speculative thought, which in medieval scholasticism constituted two poles of a hierarchical system of knowledge, with architecture relegated to the lower strata of the *artes mechanicae* alongside building trades and crafts.[7] By contrast, the Renaissance witnessed greater fluidity between both, giving rise to more productive exchanges between intellectuals and practitioners. For example, the, recognition by fifteenth-century humanists of the 'ingegno' of Filippo Brunelleschi –particularly in his design and

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[5] The earliest Italian translation of Plato's *Timaeus* was published in 1557 by Sebastiano Erizzo and printed in Venice by Girolamo Ruscelli. See Tommaso De Robertis, 'Platonic Science in the Vernacular: Sebastiano Erizzo's Italian Translation of Plato's Timaeus (1557)', paper presented at the *RSA* 2019 Toronto Conference, 17-19 March 2019 (https://rsa.confex.com/rsa/2019/meetingapp.cgi/Paper/2709). In general, knowledge of Plato by those unversed in Latin during the Early Renaissance relied on indirect sources, which followed the medieval *volgarizzamenti* of philosophical and scientific works. This practice disseminated from a 'university-based industry' of producing copies for the benefit of teachers and students. See *Science Translated: Latin and Vernacular Translations of Scientific Treatises in Medieval Europe*, eds. Michele Goyens, Pieter De Leemans and An Smets (Leuven: Leuven University Press, 2008). A good example is the 14th-century vernacular translation of Alhazen's *De aspectibus* (*De li aspetti*, transmitted in the manuscript BAV, Vat. 4595), that drew upon the Timaean relationship between elemental fire and light and the fire/light emitted by the eye, which, I argue below, influenced Alberti's *costruzione legittima*.

[6] *Lorenzo Ghiberti I Commentarii*, ed. Lorenzo Bartoli (Florence: Giunti Gruppo Editoriale, 1998), 100, 111, 302.

[7] See, for example, the *Didascalion* by Hugh of St. Victor, who expresses contempt for the mechanical arts as inferior to intellectual or theological enquiry: Christine Smith, 'Originality and Cultural Progress in the Quattrocento: Brunelleschi's Dome and a Letter by Alberti', *Rinascimento: Rivista dell'Istituto Nazionale di Studi sul Rinascimento* 28 (1988), 291-318, at 310.

execution of the dome of Florence Cathedral –elevated the practical and visual arts.[8] In the course of this change, the earlier medieval demarcation of manual labour and speculative thought became 'complementary aspects of a single subject of knowledge', in which an architect was equally skilled in the theory and application of science.[9] A key issue in this enquiry will be to determine to what extent this shift was the result of interaction with the *Timaeus* by architects and artists. In the context of the cosmic meanings of Platonic number and geometry in Renaissance architecture, the transmission from theory to practice also drew upon the parallel influences of Archimedes, engineer, inventor, and astronomer, whose famous *Quadratura Circuli* ('squaring the circle') served as both an intellectual exercise among humanists and a practical guide for architects in the application of geometrical transformations.[10] The elevation of the *artes mechanicae* in the Renaissance made it legitimate, even desirable, for architects and artists to develop the theoretical principles underlying the *Timaeus,* the most venerated philosophical work surviving from antiquity.

Early signs of the revival of Platonism in Florence, such as the writings of the Chancellor of Florence Coluccio Salutati (1331-1406), predate the renowned Platonist Marsilio Ficino. Salutati drew upon Calcidius' *Commentary* and other ancient or early Christian commentators on the dialogue – Macrobius, Boethius, and the Latin fathers – in order 'to demonstrate the substantiality of the imperishable soul'.[11] This interest in Plato continued into the early years of the Quattrocento when the leading humanist and statesman Leonardo Bruni (1370-1444) undertook a series of translations of Greek classical texts.

[8] Smith, 'Originality and Cultural Progress', 301-3.
[9] Smith, 'Originality and Cultural Progress', 313.
[10] W. R. Laird, 'Archimedes among the Humanists,' *Isis* 82 (1991), 628-38; Frank D. Prager, 'A Manuscript of Taccola, quoting Brunelleschi, on Problems of Inventors and Builders', *Proceedings of the American Philosophical Society* 112 (1968), 131-49.
[11] Charles L. Stinger, *Humanism and the Church Fathers: Ambrogio Traversari (1386-1439) and Christian Antiquity in the Italian Renaissance* (Albany: State University of New York, 1977), 79.

It is not, however, until the Council of Ferrara-Florence (1438-45) that we see the first clear evidence of an impact of Platonism on Italian humanism, when Greek scholars presented competing views about the relative merits of Platonic and Aristotelian philosophy.[12] Among the delegates attending the Council were the late Byzantine Platonists John Argyropoulos and George Gemistos Plethon, who persuasively conveyed the 'spirit' of Plato to humanists and theologians.[13] It is difficult to imagine Florentine artists and architects being unaffected by the debates surrounding this Council, which attempted to reconcile the longstanding schism between Orthodox and Catholic churches.[14]

The revival of Platonism is symptomatic of a new initiative among humanists in early fifteenth-century Florence: to collect and translate ancient texts and early medieval codices destined for major monastic libraries and private collections. Assembled through the combined efforts of wealthy patrons, such as Cosimo de Medici, and book hunters such as Poggio Bracciolini, these collections, which also included works by Archimedes, played a pivotal role during this time in disseminating knowledge and understanding of ancient Greek philosophy. Two religious centres in Florence were especially important in this regard: the Dominican Convent of San Marco and the nearby Camaldolese Convent of Santa Maria degli Angeli, both located in the city's less developed northern quarter. At the former, Cosimo founded a 'public' library in 1436, largely thanks to the noted humanist Niccolò Niccoli, who

[12] James Hankins, *Platonism in the Italian Renaissance* (Leiden: Brill, 1991), 95 remarks that 'we still have no evidence of a genuine Platonism based on a receptive reading of the dialogues. But it is an interesting sign of the underlying continuities between the humanism of the early fifteenth century and the Platonism of the later Quattrocento.' Although it is undeniable that the period of Ficino in the later fifteenth century witnessed a more receptive and systematic reading of Platonic dialogues, there is tangible evidence for the earlier period of Platonic influences on architecture and urban space that drew upon the revival of the commentary tradition, as this chapter seeks to demonstrate.

[13] For these rival views, see in particular George of Trebizond's *Comparatio philosophorum Platonis et Aristotelis*, object of polemic in *Ioannis Gatti Notata, seu, Tractatus qui erat fons Libri III Operis Bessarionis In Calumniatorem Platonis adversus Georgium Trapezuntium*, ed. John Monfasani (Turnhout: Brepols, 2021), and Gemistos Plethon's *De differentiis*, with C. M. Woodhouse, *George Gemistos Plethon: Last of the Hellenes* (Oxford: Oxford University Press, 1986).

[14] One indication of the significance of the Council of Florence is Filarete's celebrated bronze panel of a session of the council for the Jubilee Doors of St Peter's Basilica.

bequeathed his substantial collection of manuscripts to the Dominican convent.[15] Now dispersed into other libraries and archives, the collection originally occupied a purpose-built hall designed by Michelozzo Michelozzi, with a further room added later to accommodate the Greek library.[16]

Niccoli was part of a circle of humanists, theologians, poets, and artists/architects in early fifteenth-century Florence, which included Bruni, Francesco Filelfo, Giannozzo Manetti, Francesco Barbaro, Antonino (Antonino) Pierozzo, Ghiberti, Masaccio, Brunelleschi, and Alberti. From the inventory of the original collection (*repertorium sive index*), we know that the library of San Marco contained four copies of Calcidius' partial translation and commentary of the *Timaeus* which, according to the catalogue, formed part of Niccoli's private library.[17] This indicates the demand for studies of the *Timaeus* during the early Renaissance and suggests a revival in the commentary tradition. Among those who used this library, or relied on fellow humanists to interpolate and translate its collection, would have been artists, architects and humanists such as Ghiberti, Brunelleschi, and Alberti, all of whom had both practical and theoretical interests in Platonic mathematics and geometry in relation to architectural principles and the formulation of perspective (*perspectiva artificialis*). As Richard Krautheimer states:

[15] Philip Stadter, 'Niccolò Niccoli: Winning Back the Knowledge of the Ancients', in Rino Avesani et al. (eds.), *Vestigia: Studi in onore di Giuseppe Billanovich* (Rome: Edizioni di Storia e Letteratura, 1984), II, 747-64; Eugenio Garin, *La biblioteca di San Marco* (Florence: Le Lettere, 1999).
[16] Bertold L. Ullman and Philip A. Stadter, *The Public Library of Renaissance Florence: Niccolò Niccoli, Cosimo de' Medici and the Library of San Marco* (Padua: Antenore, 1972), 109.
[17] For details of these manuscripts (Naz. C.S. I,IV, 28 to S. XI) and their dates, see *Timaeus a Calcidio translatus commentarioque instructus*, ed. J. H. Waszink, Corpus Platonicum Medii Aevi, Plato Latinus, IV (London: Warburg Institute, 1962), p. cxiv. All four manuscripts were acquired 'de hereditate Nicolai de Nicolis hominis doctissimi'.

> We know that Ghiberti was in touch with Niccoli and his circle of humanists; only in their libraries could he have found and perused the writings of the ancients, and only they could have helped him when his linguistic, philological, and archaeological training failed.[18]

These wide interests should be understood in the context of the roles of Augustinian and Dominican monks as teachers of Latin and Greek in late medieval and early Renaissance Florence. This begins with the Convent of Santo Spirito where Luigi Marsili 'was nominally the head of the humanist circle of Salutati and others of the late Trecento out of which the entire Quattrocento Florentine humanist tradition sprang'.[19] Then there were the Dominicans from the convents of Santa Maria Novella and San Marco, who were renowned for their skills in religious instruction and preaching, especially on theological matters about the 'geometry of vision' in religious and public places. This is exemplified in the *Summa Theologica*, a collection of sermons delivered by Antonino Pierozzi, Prior of the Convent of San Marco and later Archbishop of Florence and venerated saint. Instrumental in bequeathing manuscripts on medieval optics for the library of San Marco, including Roger Bacon's *De multiplicatione specierum*, Fra Antonino also probably advised and promoted Brunelleschi's famous experiments in perspective.[20] Historically, the *Timaeus* served as one of the principal philosophical works from antiquity to explain the role of the human eye in illuminating the world:

> … the interlocutor Timaeus of the eponymous Platonic dialogue describes a fire within the eye that does not burn but yields a 'gentle light'. The eye itself, according to him, 'its

[18] Krautheimer, *Lorenzo Ghiberti*, 311.
[19] Field, *Origins of the Platonic Academy*, 131.
[20] Samuel Y. Edgerton, *The Mirror, the Window, and the Telescope: How Renaissance Linear Perspective Changed Our Vision of the Universe* (Ithaca: Cornell University Press, 2009), 30-8.

> middle part in particular, [is] close textured, smooth, and dense, to enable [it] to keep out all the other, coarser stuff, and to let that kind of fire pass through pure by itself'.[21]

We shall later see how the influence of *perspectiva naturalis* on the 'invention' of perspective may well have been informed by Timaean principles, in particular that the 'emanation of visual fire from the eye was understood to be rectilinear'.[22]

The other institution likely to have played a role in promoting Platonism was the Camaldolese Convent of Santa Maria degli Angeli. This became one of the principal organs in Florentine humanism for reconciling Platonic and Christian principles, before the establishment of the Platonic Academy in 1462 under Ficino. Like the earlier Augustinian Convent of Santo Spirito, the Camaldolese Convent became a major centre for teaching Latin and Greek to merchants, humanists, and artists. This was largely thanks to the activities of the monk and Hellenist Ambrogio Traversari (1386-1439), a resident of the Angeli and later Minister General of the Camaldolese Order, whose translations of Greek patristic texts and early Christian Platonic works served as essential sources for Ficino's later celebrated *Theologia Platonica*.[23]

Established in the eleventh century by Saint Romuald in the former Byzantine exarch of Ravenna, Camaldolese eremitism merged the ascetic traditions of the Greek Fathers with Platonism, a combination exemplified by the writings of the early Christian mystic Dionysius the Pseudo-Areopagite. Traversari translated both the Dionysian Corpus and Diogenes Laertius' *Lives of the Philosophers*. This compendium contained the first summary of

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[21] Smith, *From Sight to Light*, 29-30. The quotation is from Pl. *Ti.* 45b (translation adapted from Zeyl).
[22] Smith, *From Sight to Light*, 30. Smith suggests that the emanation of the visual fire from the eye was considered rectilinear because of Timaeus' assertion that the creation of a 'single, homogeneous body', through the contact of daylight with the 'visual stream', is 'aligned with the direction of the eyes'.
[23] Dennis F. Lackner, 'The Camaldolese Academy: Ambrogio Traversari, Marsilio Ficino and the Christian Platonic Tradition', in Michael J. B. Allen and Valery Rees (eds.), *Marsilio Ficino: His Theology, His Philosophy, His Legacy* (Leiden: Brill, 2002), 15-44, at 15.

Platonic philosophy available in the Latin West, which was to exert influence on Alberti's Platonic leanings.[24] Through Traversari's translation many humanists became familiar with the life of Plato and the chronology of his dialogues, including the *Timaeus*. Forming part of Diogenes' ten books, the life of Plato introduced the key themes of creation from the *Timaeus* and *Phaedo*, including an explanation of how primordial 'substance' is converted into the four elements, with their constituent geometrical (triangular) sub-structures, and the apocryphal story of Plato's purchase of 'three Pythagorean books' from Philolaus.[25] To aid this revival of Platonic learning at the Angeli, Traversari and his successor as Camaldolese General, Pietro Dolfin, assembled a library of Platonic works in the monastery, which would be expanded in the later fifteenth century to include Marsilio Ficino's own philosophical works, among them his magnum opus *Theologia Platonica*, published in 1474. Whilst there is no extant inventory of the library of Santa Maria degli Angeli for the period of Traversari's leadership, the collection probably included copies of Calcidius' commentary.[26] Traversari actively promoted the *studia humanitatis* within the community of monks and humanists at Santa Maria degli Angeli, where he taught such eminent figures as the diplomat and humanist Giannozzo Manetti.[27] Among the initiatives to promote the *studia humanitatis* was the establishment of a 'private interlibrary loan service which played so significant a role in the intellectual life of the early fifteenth century', including the circle of artists and architects who were at the fringes of the humanist group.[28]

[24] Lackner, 'Camaldolese Academy', 18.
[25] Diog. Laert. 3.9. A presentation copy of Traversari's translation of the *Vita Platonis* can be found in the Biblioteca Laurenziana in Florence: MS Laur. LXV.21, dated 8 February 1433. For a recent English translation of Laertius' *Lives,* see *Lives of the Eminent Philosophers: Diogenes Laertius,* ed. James Miller and trans. Pamela Mensch (New York: Oxford University Press, 2018).
[26] Stinger, *Humanism and the Church Fathers*, 56.
[27] Stinger, *Humanism and the Church Fathers*, 66-82.
[28] Krautheimer, *Ghiberti*, 311.

3 Situating Platonic Cosmology in Civic/Sacred Space

To understand the influence of the *Timaeus* on architecture as both a discipline and a practice it is important to recognise the distinctive characteristics of Florentine culture from the mid-fourteenth to the early fifteenth centuries. This was a period of 'civic humanism', when antiquarian interests in the classical past were shaped by an emphasis on the political community, as opposed to the individual, and its judicial/civic authority.[29] An essential ingredient of this community was the role of rhetoric in public speech and its architectural and urban settings. As Charles Stinger observes, in the context of the Florentine statesman Leonardo Bruni, '…rhetoric replaced logic as the essential linguistic character. Language was seen as affective and empirical, relevant to man's position in historical times, not as a logical symbol of metaphysical reality.' Ernesto Grassi echoes this point in his counter-argument to Martin Heidegger's claim that humanism is 'stamped in the mold of metaphysics.'[30] In his Latin edition of Plato's works, Bruni effectively presents Plato as both a 'republican' and a 'civic humanist'.[31] We will see later how this emphasis on rhetoric, and its broadly civic dimensions in the early Renaissance, took precedence over cosmological meanings in Alberti's approach to the *Timaeus*. The reception of Plato during this time, demonstrated in interpretations of Calcidius' Commentary, was therefore a matter not just of *what* was described, concerning the creation of the cosmos, but also *how* these accounts were communicated through eloquent language and forms of mathematical or geometrical reasoning.

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[29] Hans Baron, *In Search of Florentine Civic Humanism: Essays on the Transition from Medieval to Modern Thought. Vol. 1* (Princeton: Princeton University Press, 1988).
[30] Stinger, *Humanism and the Church Fathers*, 107; Martin Heidegger, 'Letter on Humanism', in *Martin Heidegger: Basic Writings*, ed. David Farrell Krell (San Francisco: Harper Collins Publishers, 1993), 213-65, at 215. For Grassi's argument, see above, n1.
[31] Hankins, *Plato in the Italian Renaissance*, 58-81.

Salutati's role as Chancellor of the Florentine *signorie* from 1375 until his death in 1406 coincided with the final stages in the completion of the Piazza della Signoria that surrounds two sides of the Palazzo Vecchio, the headquarters of the *signorie*. Salutati had secured the appointment of the Byzantine scholar Manuel Chrysoloras to teach Greek grammar and literature in Florence, and his intense interest in Plato provides the intellectual context for the conception and development of the geometrical layout of the piazza. Marvin Trachtenberg has shown that its design follows the principle of a rotational square, with the diagonal of the smaller square, corresponding to the *Platea Ubertorum*, being approximately equal to the sides of the major square, the Piazza della Signoria.[32] This relationship between major and minor squares, redolent of the geometrical problem addressed in Plato's *Meno*, was also used as a device to generate the design of sacred spaces in the later Middle Ages, including the east end of Santa Maria del Fiore.[33]

[Insert here Fig. 14.1]

Fig. 14.1: Plan of the Piazza della Signoria, Florence, showing its simplified geometrical arrangement, based on the rotational square (X & Y), according to Trachtenberg. Redrawn by Stephen Calcutt.

As if to complete the geometry of the major square of the Piazza della Signoria in a third dimension, the architects of the Palazzo Vecchio designed the belfry overlooking the piazza so that its height matched the sides of the square.[34] The resulting arrangement is a cube generated by the diagonals and sides of the piazza, which, from the vantage point of the

[32] Marvin Trachtenberg, *Dominion of the Eye: Urbanism, Art, and Power in Early Modern Florence* (Cambridge: Cambridge University Press, 1997), 114-24.
[33] Trachtenberg, *Dominion of the Eye*, 114-24.
[34] Trachtenberg, *Dominion of the Eye*, 232-41.

corner of the piazza at via Calzaiuoli, Trachtenberg tentatively calls –the 'Euclidean Piazza'.[35]

[Insert here Fig. 14.2]

Fig. 14.2: Volumetric projection of the Piazza della Signoria, indicating cuboid volume of the principal square, in relation to the height of the campanile of the Palazzo Vecchio, after Trachtenberg. Redrawn by Stephen Calcutt.

The symbolic significance of the Piazza della Signoria as civic space might best be described as having the role of a 'receptacle' of public speech emanating from the *Ringhiera*, the orator's platform at the corner of the Palazzo Vecchio. It is as if the cosmic understanding of the cube in the *Timaeus* (55d-e), as the geometry of earth generated by a combination of right-angled isosceles triangles, is transposed into the principal political arena of the city. Through this transposition, the rhetorical dimensions of oratory become consonant with the rhetorical narrative and geometry of Plato's dialogue which Salutati and other humanists of the period recognised.[36]

[35] Trachtenberg, *Dominion of the Eye*, 236. In these projective characteristics, the 'Euclidean' features of the Piazza della Signoria provide a useful backdrop to assessing more generally the influence of Euclid in the transposition of Timaean principles into optically constructed or represented space during the Renaissance. The interest in Euclid during the Renaissance is evident from the presence of a copy of Campanus of Novara's thirteenth-century Latin translation of the *Elements* in the library of Santo Spirito: Bertold L. Ullman, 'Geometry in the Mediaeval Quadrivium', in Romeo de Maio (ed.), *Studi di Bibliografia e di Storia in Onore di Tammaro de Marinis*, vol. 4 (Verona: Biblioteca Apostolica Vaticana, 1964), 263-85. Alberti perhaps consciously borrowed Euclid's title in his *Elementi de pittura* (*c.*1435) and arguably developed the first Renaissance example of the geometric method in the opening of his *De pictura*, probably inspired by Euclid's *Elements*: Jens Høyrup, 'Euclid: Reception in the Renaissance', in Marco Sgarbi (ed.), *Encyclopedia of Renaissance Philosophy* (Cham: Springer, 2019), 1-10, at 2. For the *De Pictura*, see *Leon Battista Alberti, Opere volgari. III. Trattati d'arte, Ludi rerum mathematicarum, grammatica della lingua toscana, Opuscoli amatori, Lettere*, ed. Cecil Grayson (Bari: Laterza, 1973), 6-107. The most explicit visual demonstration of an inherited relationship between Euclidean, Platonic, and Pythagorean traditions, that formed the philosophical framework for perspectival and architectural developments in the Renaissance, is Raphael's *School of Athens* (1509-11): Nicholas Temple, *Renovatio urbis: Architecture, Ceremony and Urbanism in the Rome of Julius II* (London, Routledge, 2011), 214-62.

[36] The 'rhetorical' qualities of the *Timaeus* target 'the dialogue at a readership that is thoughtful and open but not philosophically educated, … a readership that has not undertaken … the "longer way"….that leads through the "turning of the soul" from Becoming to Being': Mitchell Miller, 'The Timaeus and the "Longer Way": "God-Given" Method and the Constitution of Elements and Animals', in Gretchen J. Reydams-Schils (ed.),

However, the civic and terrestrial dimensions of the cubic geometry of the Piazza della Signoria only become meaningful when understood in the context of the spaces and buildings that surround it, indicating that Platonic symbolism, seen through the lens of civic humanism, requires involvement of the city as a microcosm of divine creation. This involvement is allegorized through the apodictic structure of geometry, which gives rise to a matrix of analogies re-inscribed within classical culture involving music/harmony, micro/macrocosm, court/church ceremony, homo/deus faber, and other relationships.[37] Given the fertile analogy between Timaean geometry, rhetoric, and optics in the Piazza della Signoria, it is perhaps unsurprising that Brunelleschi later chose this public space as the location for his second 'perspective experiment', using the vantage-point of via Calzaiuoli for his pictorial reconstruction.[38]

In the transition between the late fourteenth and early fifteenth centuries, the application and appropriation of geometrical principles to civic spaces, in which buildings serve as framing devices for public ceremony and oratory, witness a new emphasis on the proportional arrangements of individual buildings as geometrical entities *within* the cityscape. George Hersey summarises this as a relationship between 'Cubism and Spherism' or, in

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Plato's Timaeus as Cultural Icon (Notre Dame, Ind: University of Notre Dame Press, 2003), 17-59, at 17. Through this process, the difference between ideal model and likeness is crucial, which in the case of the Piazza della Signoria is 'measured' spatially and optically by the qualities of light and shadow. For a description of the Piazza della Signoria, see Nicholas Temple, *Architecture and the Language Debate: Artistic and Linguistic Exchanges in Early Modern Italy* (London: Routledge, 2020), 59-64.

[37] We see this, for example, in Domenico Ghirlandaio's *Confirmation of the Franciscan Rule* (1483-86) in the Sassetti Chapel, Basilica of Santa Trinità. This fresco depicts St. Francis' reception by Innocent III at San Giovanni in Laterano in 1209, the official establishment of the Franciscan Order, but shows it taking place not in Rome but in Florence, which many humanists regarded as the new Rome or Jerusalem, with the background of the Piazza della Signoria and the adjacent Palazzo Vecchio and Loggia dei Lanzi. In the foreground, a semi-enclosed seating area and papal throne intended to represent the cathedral of Rome in abbreviated form, frames perspectivally the background of the piazza. The painting shows the transposition of the Piazza della Signoria behind to the foreground where the principal scene takes place, projected along the central axis of the Loggia dei Lanzi, and thus the convergence of Platonic geometry, perspective, and symbolic depiction as mutually dependent elements.

[38] Temple, *Architecture and the Language Debate*, 59-64; cf. 4-10, referring to Peter Carl's correlation of perspective with classical rhetoric in a diagram that describes analogical relationships between word and image.

architectural terms, between cubic and domical arrangements.[39] We see this in particular in the layout and configuration of Renaissance palaces and churches or chapels that served as complementary building typologies in the city's civic space:

> Like Alberti, Ficino claims that the most beautiful form-source for architecture is the cube. Echoing the Pythagoreans he emphasises its solidity and stability with Earth. But for Ficino, Earth is not only a cube; it is a cube pervaded by a sphere.[40]

This latent presence of 'sphericity' is expressed in Chapter 41 of Ficino's *Compendium*, which describes the corresponding relationships between Platonic solids and natural elements, the basis of his proportional system of cosmic and musical harmony.[41]

Represented anthropomorphically in Leonardo da Vinci's famous drawing of 'Vitruvian Man', the generating principles of the square and the circle mirror the creation narrative underpinning the *Timaeus*.[42] Accordingly, man is represented as the symbolic microcosm located at the centre of the universe. This emerges when we examine the relation between the figure and surrounding geometry (*homo ad quadratum* and *homo ad circulum*) in the context of Alberti's assertion that a curve forms 'part of the circle, and the circle, according to the philosophers, [is] all angle'.[43] The superimposed postures of the standing and outstretched figure occupy the square and circle simultaneously, as if mediating between earthly and celestial realms. While the square encompasses the upright posture, the diagonal

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[39] George L. Hersey, *Pythagorean Palaces: Magic and Architecture in the Italian Renaissance* (Ithaca: Cornell University Press, 1976), 35.
[40] Hersey, *Pythagorean Palaces*, 35.
[41] For an account of Ficino's cosmic harmony in the 'music of the spheres', see Grantley McDonald, 'The Reception of Ficino's Theory of World Harmony in Germany', in Jacomien Prins and Maude Vanhaelen (eds.), *Sing Aloud Harmonious Spheres: Renaissance Conceptions of Cosmic Harmony* (London: Routledge, 2018), 160-82, with reference to Chapter 41 of Ficino's commentary at 172 n. 59.
[42] See Francis M. Cornford's study of 'Circles in the World-Soul' in *Plato's Cosmology*: *The* Timaeus *of Plato* (Indianapolis: Hackett Publishing Company, 1935; repr. 1997), 82-97.
[43] Leon Battista Alberti, *De Re Aedificatoria* 1.8, 12v, in *Leon Battista Alberti, On the Art of Building in Ten Books*, trans. Joseph Rykwert, Neil Leach, and Robert Tavernor (Cambridge, MA: MIT Press, 1996), 20.

arms and splayed legs transgress this orthogonal enclosure by inscribing the circumference. The mismatch between the relative positions of the square and circle in Leonardo's diagram is therefore accounted for by the way in which the transformation from one to the other occurs through the shifting position of arms and legs from horizontal to oblique positions. In the course of this transition, it becomes apparent that the splayed legs form an equilateral triangle within the circle, with the upper apex located at the navel, which is also the centre of the circle inscribed by the outstretched body.[44]

Underlying the square-circle relationship in Leonardo's drawing is a familiar geometrical problem of 'squaring the circle', articulated by Archimedes and underpinning Ficino's principle, expressed in his *Timaeus* commentary, of the cube being 'pervaded' by the sphere.[45] As an intellectual exercise, geometrical solutions to the squaring of the circle also informed design processes in building. The German humanist and theologian Nicholas of Cusa dedicated two works on this theme, *De Geometricis Transmutationibus* and *De Arithmeticis Complementis* (both 1450), to the Florentine mathematician and astronomer Paolo dal Pozzo Toscanelli, who supposedly helped Filippo Brunelleschi to resolve the geometry and engineering of his dome for Florence Cathedral, by using this mathematical solution.[46] Little survives of Toscanelli's geometrical work, but he may have been the author of a treatise on perspective previously attributed to A|lberti.[47] Such examples show the

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[44] As Leonardo states: 'If you open your legs so much as to decrease your height 1/14 and spread and raise your arms till your middle fingers touch the level of the top of your head you must know that the centre of the outspread limbs will be in the navel and the space between the legs will be an equilateral triangle. The length of a man's outspread arms is equal to his height.' *The Notebooks of Leonardo da Vinci,* Vol.1, ed. Jean Paul Richter (New York: Dover Fine Arts Books, 1970), 182.

[45] For the articulation of this problem by the Antonine architect Aelius Nicon, see Chapter 5 above, by Edmund Thomas.

[46] Leon Battista Alberti, De Lunularum Quadratura', in *The Mathematical Works of Leon Battista Alberti*, eds. Kim Williams, Lionel March, and Stephen R. Wassell (Basel: Springer Basel AG - Birkhauser, 2010), 201-12, esp. commentary by March, 209-12.

[47] Marshall Clagett (ed.), *Archimedes in the Middle Ages, Vol. 3. The fate of the medieval Archimedes. Part 3. The Medieval Archimedes in the Renaissance, 1450-1565* (Philadelphia: American Philosophical Society, 1978), 318; Karsten Harries, 'On the Power and Poverty of Perspective: Cusanus and Alberti', in Peter J. Casarella (ed.), *Cusanus: the legacy of learned ignorance* (Washington, D.C.: Catholic University of America Press, 2006), 105-26, at 107.

practical applications of geometry in building, through *artes mechanicae*, which brought into play the symbolic meanings of number and geometry underlying the Christian-Platonic tradition. More directly, the configuration of the Rotunda of Santa Maria degli Angeli gave both material and spatial expression to Timaean principles, as explained below.

Alberti too was interested in this geometrical 'puzzle', as we see from *De lunularum quadratura* ('On Squaring the Lune') attributed to the humanist.[48] This work, however, follows a different geometrical procedure from the more familiar approach in which 'areas of inscribed and circumscribed polygons converge on the area of the circle as the number of sides increased, most commonly 6, 12, 24, 48, 96 sides'; this had been the basis of the design of complex polygonal and domical structures such as the rotunda of Santa Maria degli Angeli. Alberti instead develops a method of squaring arcs or curvilinear shapes, or 'lunae', using partial curves of 'lunar' circles. This departs from the more common 'centrifugal' transformation of geometry by applying a series of tangentially generated arcs. The method draws upon Euclid's dictum that 'circles are to one another as the squares on the diameters'.[49] The approach, moreover, reinforces Alberti's claim, referred to earlier, that the circle is 'all angle', thereby echoing Plato's principle of the triangle as the originating geometry of the four elements in the *Timaeus*.

Leonardo's drawing of 'Vitruvian Man' provides a clue to how triangles constitute the generating unit of the cosmos embodied in the human form, which in turn demonstrates the familiar Protagorean dictum, 'man is the measure of all things'.[50] We should, of course, note

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[48] Williams, March, and Wassell, *Mathematical Works*, 201-12. The work is attributed to 'Battista Alberto', so the identification with Alberti is not absolutely certain.

[49] Euc. *Elements*, 12.2. Williams, March, and Wassell, *Mathematical Works*, 78. Joan Gadol suggests that Alberti may have written *De lunularum quadratura* to resolve a problem arising from the method used to survey Rome (*Descriptio Urbis Romae*), a key part of which required searching for a value of π: *Leon Battista Alberti: Universal Man of the Early Renaissance* (Chicago: University of Chicago Press, 1973), 78; March, in Williams, March, and Wassell, *Mathematical Works*, 209-12.

[50] The overlapping of circles (such as the *vesica piscis*) generate perfect triangles and hexagons. On the latent presence of *vesica piscis* in the Vitruvian Man see Vitor Murtinho, 'Leonardo's Vitruvian Man Drawing: A New Interpretation Looking at Leonardo's Geometric Constructions', *Nexus Network Journal: Architecture and Mathematics* 17 (2015), 507-24.

the underlying Christological symbolism of this triadic‘(trinitarian) arrangement. In its pivotal movement, the body enacts a transformation from the right angle, emblematic of the mortal, crucified Christ on the cross, to the oblique, evocative of resurrection and divine immortality. While the former is upright, static, and ‘grounded in the square’, the circle (in which the latter is inscribed) gives it rotational force. In this sense, Platonic geometry serves as a ‘measure’ of the Incarnation. The wellspring of this threefold geometry of square, circle, and equilateral triangle is traceable to the sacred number ten, which, according to Vitruvius, Plato considered to be perfect. The basis of the ‘Pythagorean’ tetractys, traditionally represented in the form of a triangle shaped by an ascending series of units from four to one that comprise the numbers found in musical harmonics, these numbers are Vitruvius’ starting point for the principle of symmetry in his ‘classification’ of temples.[51] The tetractys served as the initial generating sequence for Plato’s division of the World-Soul into harmonic intervals, which after Theon of Smyrna became known as a triangular lambda, from which forged a series of proportional relationships that influenced the architecture of Alberti.[52]

Lionel March has argued that Alberti’s *De Re Aedificatoria* ‘is working strictly within the Pythagorean tradition which….had been given additional authority by Plato in the *Timaeus*’.[53] Indeed, it seems clear that the influence of the *Timaeus* on Alberti’s architectural thinking derived from a combination of direct references to the text and commentaries that served as a ‘yardstick’ for articulating the principles of building. In Book Nine, Alberti differentiates between the ornament of the villa and the town house, showing how the latter is more sober and restrained. This is demonstrated in the way the rectangular *area* of urban

[51] Vitruvius wrote his treatise at a time of intense interest in Pythagoreanism and Plato’s *Timaeus.* See Miriam Griffin, ‘The Intellectual Developments of the Ciceronian Age’, in John A. Crook, Andrew Lintott; Elizabeth Rawson (eds.), *Cambridge Ancient History, Vol. IX. The Last Age of the Roman Republic 146-43 B.C.* (Cambridge: Cambridge University Press, 1994), 689-728.
[52] Pl. *Ti.* 35b-c; Theon, *Expositio* 38.
[53] Lionel March, *Architectonics of Humanism: Essays on Number in Architecture* (Chichester: Academy Editions, 1998), 93.

palaces, shaped by the stacking of 'storey above storey', partly retraces the ancient orthogonal plan of Florence within the existing layout of the city, combined with the decorum of the building's public face towards the street.[54] This relationship between building block and urban layout reinforces Alberti's analogy between city and house, extending his idea of subdivision (*partitio*) whereby a building comprises interconnected smaller units.[55] This relation of parts to the whole recalls the Timaean model of cosmology based on the transformation of elementary geometries into primary bodies.

Exploring the analogies between musical harmonics and architectural proportion, Alberti later departs from whole number relationships by examining the roots and powers of numbers in the cube:

> A root is the side of a squared number, whose power equals the *area* of that square. The cube is the projection of the square…..it is said to be the one solid that is particularly stable and that rests equally sure and steadfast on any of its sides.[56]

This description of the cube reminds us of Plato's account in the *Timaeus*:

> To earth let us assign the cubical figure; for of the four kinds earth is the most immobile and the most plastic of bodies. The figure whose bases are the most stable must best answer that description…[57]

If Alberti drew directly on Plato's description when emphasising the stability of the cube, he interprets this quality somewhat differently. While Plato refers to its cosmogonic attributes as 'earth', Alberti highlights its innate geometrical characteristics. The conscious application of cubic geometry is visible in the design of fifteenth-century Florentine palaces such as the

[54] *De Re Aedificatoria* 9.2, 159v; *On the Art of Building,* 294.
[55] *De Re Aedificatoria* 1.9, 13v; *On the Art of Building,* 23.
[56] *De Re Aedificatoria* 9.6, 168v; *On the Art of Building,* 307.
[57] Pl. *Ti.* 55d-e.

Palazzo Medici and Palazzo Strozzi, begun in 1444 and 1489 respectively. As expressions of the status and power of wealthy merchant families, these prism-like civic structures address the street by their heavy rustication and articulated corners that emphasise their geometrical autonomy.[58]

[Insert Fig. 14.3 here]

Fig. 14.3: Ground floor plan of the Palazzo Medici, Florence, showing a fairly regular geometrical layout with central cortile surrounded by state rooms or offices. Drawing by Manwinder Lall.

[Insert Fig. 14.4 here]

Fig. 14.4: View of the Palazzo Medici, indicating cubic massing of the building as made visible by its corner location with large overhanging eaves. Wikimedia Commons.

Whereas the ground floor plans reinforce this cubic geometry, with centrally located cloisters and surrounding rooms accommodating business and mercantile activities, the upper floors become less geometrically concise because of the more informal planning arrangements of domestic spaces. As settings where domestic and commercial activities overlapped in the civic life of the city, these buildings re-articulate the Timaean principle of the cube as terrestrial (earth-bound) geometry.

Alberti was personally acquainted with the younger Ficino, which as Kathryn Blair Moore suggests may partly explain the presence of architectural themes in Ficino's

[58] The use of rustication in Renaissance palace facades, and its conscious reference to all'antica models, may be seen as part of the Albertian Compartition matrix, evidenced in the application of geometrical configurations (chamfered rectangles, square pyramids) that constitute hybrid versions of Timaean geometrical units.

writings.[59] The acquaintance correspondingly reinforces the likelihood that Alberti influenced Ficino's Platonism, specifically concerning the role of proportion and musical harmonics in the conception of space. Drawing upon a long tradition of musical harmonics from Pythagoras and Plato to Boethius and St. Augustine, Alberti skilfully applies these ratios to 'define the limits of architectural elements'.[60] Their architectural manifestations are apparent from his design of the Cappella Rucellai, undertaken in 1467 during the period of his influence on the young Ficino.[61] Angela Pintore has shown how Alberti's account of 'Pythagorean' ratios in his architectural treatise broadly follows their application in the Cappella Rucellai. Importantly, Alberti 'recommends the use of the musical proportions not only to define areas but to delimit volume as well', as Pintore beautifully demonstrates in her analysis.[62] Her study emphasises the importance of the *Timaeus*, and its supporting commentaries, as a bridge between the 'Pythagorean' and Neo-Platonic traditions of harmonics that informed Alberti's theory and practice of architecture.[63] It is in this context that Alberti's knowledge of musical ratios, through the *Timaeus*, played a role in the development of Ficino's twofold theory of music: divine music and its 'impression' in the human soul.

Perhaps the most important aspect of Alberti's approach to architecture that demonstrates an affinity with the *Timaeus* concerns the idea of the 'immaterial design of a building' using *lineamenta*, a term denoting a schematic outline derived from the mind.[64]

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[59] Kathryn Blair Moore, 'Ficino's Idea of architecture: the "mind's-eye view" in Quattrocento architectural drawings', *Renaissance Studies* 24 (2009), 332-52; Arnaldo della Torre, *Storia dell'Accademia Platonica di Firenze* (Florence: G. Carnesecchi, 1902).

[60] Angela Pintore, 'Musical Symbolism in the Works of Leon Battista Alberti: From De re aedificatoria to the Rucellai Sepulchre', *Nexus Network Journal* 6 (2004), 49-70, at 62.

[61] Moore, 'Ficino's Idea of architecture', 351-2: 'Ficino himself recorded Alberti's presence at the Platonic Academy in Florence in the 1460s, referring to him as a "Platonic mathematician," while in 1468 Cristoforo Landini described conversations between Ficino and Alberti on philosophy.'

[62] Pintore, 'Musical Symbolism', 67; cf. *De Re Aedificatoria* 9.5, 167; *On the Art of Building*, 305-6.

[63] Pintore, 'Musical Symbolism', 61.

[64] *De Re Aedificatoria*, Book 1, 4-20; *On the Art of Building*, 7-32 and 422-3 (Glossary). Ficino explains in his *Platonis Opera Omnia* (1484) 'how one might understand the original design of a material building through anagogy [mystical interpretation]'. Moore, 'Ficino's Idea of architecture', 332-52.

Alberti argues that the design process in architecture entails two parts, *lineamenta* and *materia*, of which the latter denotes the physical attributes of building materials derived from nature. The relationship between both is facilitated through the skills and knowledge of the architect. Alberti recognised the key role of proportion in linking these two parts, particularly in the way encompassing and intermediate lines, that form the 'framework' for the partitioning of spaces within a building enclosure, bring the 'mental lines' of *lineamenta* in harmony with *materia*. This relationship also has a bearing on the structure of Alberti's architectural treatise, as I shall demonstrate later. March argues that *lineamenta* constitute in their invisibility a more perfect reflection of the actual building, redolent of the Platonic concept of Ideal Forms.[65] Integral therefore to this Albertian model of architecture is 'the *eidos* or mental image, manifested in an "eidetic mesh" of invisible lines underlying the plan, rather than measures and shapes that can actually be seen by the visitor'.[66]

These 'mental' relationships recall the role of the Receptacle (Chora) in Plato's *Timaeus* in the Demiurge's creation of the cosmos. Through its fashioning of the World-Soul, the Receptacle provided a fertile cosmic analogy for the role played by Alberti's *lineamenta* in architectural conception. Edging towards a more perfect 'likeness', *lineamenta* are absorbed into Alberti's overarching principle of *concinnitas* ('the absolute and fundamental rule of nature' and hence the 'main object of the art of building'), comprising a combination of *numerus* (number), *finitio* (outline) and *collocatio* (position).[67] In bringing these elements into union, 'qualitative traces receive their geometric features.'[68] This merging of geometrical and rhetorical qualities in the Renaissance reception of the *Timaeus* stems partly from

[65] March, *Architectonics of Humanism*, 49-52. See also Lionel March, 'Renaissance mathematics and architectural proportion in Alberti's De re aedificatoria', *Architectural Research Quarterly* 2.1 (Autumn 1996), 54–65, which examines Alberti's use of the Platonic solids in relation to the *Timaeus* and Boethius.
[66] Richard Padovan, *Proportion: Science, Philosophy, Architecture* (London: Spon Press, 1999), 227.
[67] *De Re Aedificatoria* 9.5, 164-5; *On the Art of Building*, 302-3 and 421-2 (Glossary).
[68] Kenneth Sayre, 'The Multilayered Incoherence of Timaeus' Receptacle', in Reydams-Schils (ed.), *Plato's Timaeus as Cultural Icon* (Notre Dame, Ind: University of Notre Dame Press, 2003), 60-79, at 67.

Cicero's *De Oratore*, which exerted a major influence on fifteenth-century humanism, not least in Alberti's conception of architectural order.[69]

In the context of Alberti's *De Re Aedificatoria*, it is possible to trace an emulation of the *Timaeus* in the arrangement of themes or topics in the treatise and its progression from lineaments to ornament and the restoration of buildings:

> [W]e find that [the] structure of the treatise follows the Platonic progression from the general immaterial Idea to the material particulars. In the preface, Alberti divides the process of building into the establishment of the immaterial geometrical ordering in the mind of the architect – which he refers to as the *lineamenta* – followed by the organic development of the building into material form according to this mental schema.[70]

In Books 7, 8, and 9, Alberti examines the ornament of sacred, public, and private buildings, in which the circle and square, or rectangle, serve as two complementary geometries in the construction of civic and religious spaces, mediated through the proportional relationships of the human body. Wittkower reminds us how the 'geometrical definition of God through the symbol of the circle or sphere' has a long pedigree, constituting a central principle of Plato's cosmological myth in the *Timaeus*.[71]

The best demonstration of how this cosmic geometry was understood architecturally is the Rotunda ('Tempio degli Scolari') of Santa Maria degli Angeli. As the first centralised church, or, to be more precise, 'concentric polygonal sacred building', constructed in the

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[69] Alberti's definition of beauty in *De Re Aedificatoria*, 6.2, 93-4 derives from Cicero's description of the perfection of the human body in *De Ora*. 3.178-80. Rykwert et al., *Alberti, On the Art of Building*, 155-7, with 386 n.6.

[70] Moore, 'Ficino's Idea of architecture', 347-8.

[71] Rudolf Wittkower, *Architectural Principles in the Age of Humanism* (London: Academy, Editions, 1977), 28. This particularly refers to Nicholas of Cusa, but reflects a more general understanding of the significance of the *Timaeus* in the early Renaissance.

Renaissance, the Rotunda played a decisive role in communicating Platonic ideas architecturally to humanists and religious figures.[72] It was in 'this famous place' (*celebri hoc loco*), to use his own words, that Ficino delivered orations from as early as 1469.[73] Indeed, he seems to have had a particular fondness for the space as a setting for communicating Plato's ideas, perhaps recognising the close alliance of its form, geometry, and symbolism with Plato's philosophy: 'Following as best we may, the path trodden by ancient sages, we will therefore follow the holy philosophy of Plato here in the church. In this seat of the angels [*sedes angelorum*, the name of the monastery] we will contemplate divine truth.'[74]

[Insert Fig. 14.5 here]

Fig. 14.5: Reconstruction of the plan and section of the Rotunda of S. Maria degli Angeli, Florence, according to Eugenio Battisti. Redrawn by Manwinder Lall.

[Insert Fig. 14.6 here]

Fig. 14.6: View of the Rotunda of Santa Maria degli Angeli, from the *Codex Rustici, c.* 1447. Florence, Library of the Seminario Arcivescovile Maggiore.

Begun in 1434, following the appointment of Brunelleschi as architect, the project was later abandoned in 1437.[75] The design and configuration of the Rotunda has been the

[72] Charles Stinger, 'Ambrogio Traversari and the "Tempio degli Scolari" at S. Maria degli Angeli in Florence', in Sergio Bertelli and Gloria Ramakus (eds.), *Essays Presented to Myron P. Gilmore, Volume 1. History*, Villa I Tatti, Harvard University Center for Italian Renaissance Studies 2 (Florence: La Nuova Italia, 1978), 271-86.
[73] Lackner, 'The Camaldolese Academy', 31 and 33-4: the pedagogic function of the space was first implemented by Traversari's successor as Camaldolese General, Pietro Dolfin, who used the Rotunda to teach both Platonic and patristic works.
[74] *Divini Platonis opera omnia*, ed. Marsilio Ficino (Lyon: Nathaniel Vincent, 1588), 886. Translation from *The Letters of Marsilio Ficino*, vol. VII, trans. Clement Salaman (London: Shepheard-Walwyn, 2004), and *Marsilio Ficino, The Philebus Commentary*, ed. and trans. Michael J. B. Allen (Berkeley: University of California Press, 1975), 9 and 522-3. Quoted in Lackner, 'The Camaldolese Academy', 31 n. 50. As Lackner states, citing Allen, '[Ficino's use of] the words *vestigia* and *media* would be especially appropriate if the ecclesia were the Rotunda'.
[75] Eugenio Battisti, *Brunelleschi: The Complete Works* (London: Thames and Hudson, 1981), 250.

subject of much scholarly debate, but the question of the influence of Platonic philosophy, particularly the *Timaeus*, on the building's geometry has not been directly addressed. Of particular interest is the geometrical precision of the layout of the oratory, as Eugenio Battisti observes:

> The Rotunda is the most notable example in Brunelleschi's work of a design determined by the compass. Given the outer circumference one can construct the sixteen-sided polygon, and the internal octagons can be drawn from a series of concentric circles. Thus the exterior walls form the sixteen-sided polygon; the outer walls of the passages between chapels mark an octagon, and their inner walls follow a circle inscribed in that octagon, while the major piers mark the corners of another inner octagon…..By dividing the overall diameter into sixty-four equal parts and drawing the corresponding concentric circles one can fix references from which many structural elements of the chapels can be traced…..Still undetermined is the geometrical construction of the niches and the triangles, each with one of the sixteen outer sides as its base, which enclose the supporting piers.[76]

This summary of the geometry of the Rotunda indicates how the architect may have understood the building configuration as a series of interdependent parts that 'unfold' as geometrical elements from circles to triangles redolent of the creation myth in the *Timaeus*. Concretised in the hierarchical arrangement of spaces, this unfolding geometry prompts the viewer to experience the Rotunda as if in a constant state of 'becoming'. This perennial transformation, from triangle to square, octagon, sixteen-sided polygon, and finally sphere or dome, recalls the geometrical puzzle of squaring the circle, but in reverse, from the chthonic and terrestrial to the celestial realms.

[76] Battisti, *Brunelleschi*, 251.

Ficino used architectural analogies repeatedly in his *Theologia Platonica* (1482). He was especially receptive to the principle of God as an architect, a characterization that developed in the Middle Platonist tradition. Proclus interpreted Plato's Demiurge as an 'architect of all becoming', who wanted all things to be good, like himself, and took the statement that he led '"all that is visible" "out of disorder into order" as proof 'that God wills the non-existence of evil'.[77] Similarly, Ficino wrote:

> [S]ince the amazing order of the world could not come about through chance devoid of order, [its] form must necessarily exist in the understanding of its maker, in whose likeness it is made. And since the order of the universe is the most important for God's plan, the principal idea with Him is the idea of the universe's order. But one cannot conceive of the rational principle of the order and of the whole unless one [first] conceives of the rational principle proper to all the parts from which the whole is constituted, just as an architect cannot conceive of the appearance of a building unless he has conceived of the reasons proper to its parts.[78]

Alberti may have played a part in the choice of geometry for the Rotunda. In Book Seven of his *De re Aedificatoria*, 'Ornament to Sacred Buildings', he provides a detailed account of the appropriate configurations of ideal churches, beginning with what Wittkower has called his own 'eulogy of the circle', following the famous one in the *Timaeus*:[79]

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[77] John Phillips, *Order from Disorder. Proclus' Doctrine of Evil and Its Roots in Ancient Platonism* (Leiden: Brill, 2007), 10, citing Procl. *In Ti.* 29a-d and 29d-30a.. For more on the architectural analogy in Middle Platonism, see Chapters 1 and 5, above.

[78] *Marsilio Ficino. Platonic Theology Books I-IV, Vol. 1*, trans. Michael J. B. Allen with John Warden, Latin text ed. James Hankins with William Bowen (Cambridge, MA: Harvard University Press, 2001), 171 (Book II Chapter XI). Quoted in Moore, 'Ficino's Idea of architecture', 340.

[79] Wittkower, *Architectural Principles*, 3. For the eulogy of the circle in the *Timaeus*, see Thomas, Chapter 5, above.

> It is obvious that all that is fashioned, produced, or created under her influence, that Nature delights primarily in the circle. Need I mention the earth, the stars, the animals, their nests, and so on, all of which she made circular?…The round plan is defined by the circle. In almost all their quadrangular temples our ancestors would make the length [of the plan] one and a half times the width….For many-sided plans, the ancients would use six, eight, or even ten angles. The corners of all such plans must be circumscribed by a circle.[80]

It is possible that Byzantine architecture, in particular San Vitale in Ravenna, had an influence on the polygonal form of the Rotunda, not least because Traversari visited San Vitale and praised its layout and exquisite mosaics.[81] Brunelleschi too may have been influenced by the architecture of Ravenna in his use of vaulting *senza armadura*.[82] As noted earlier, the Camaldolese Order was established there, and Traversari repeatedly asserted the importance of patristic sources and the religious practices of the Early Christian and Byzantine periods for reforming the Catholic Church. Given Traversari's belief in the historical influences of Platonism on patristic texts, it seems very plausible that he recognised similar relationships in architecture, like Brunelleschi in his design of the Rotunda.

4 The *Timaeus* and the Square Pyramid of Linear Perspective

[80] *De Re Aedificatoria*, 7.4, 114v; *On the Art of Building*, 196. For the eulogy in the *Timaeus*, see Chapter 1, above.
[81] There is evidence that Brunelleschi personally knew Traversari, since Traversari probably provided Brunelleschi with Giovanni Aurispa's manuscript of the mathematical treatise on ancient lifting devices by Pappus of Alexandria, which refers to a precedent for the worm-gear mechanism that was essential for the construction of the dome of Florence Cathedral. Smith, 'Originality and Cultural Progress', 312, citing Stinger, 'Ambrogio Traversari and the "Tempio degli Scolari"', 279.
[82] Stinger, 'Ambrogio Traversari and the "Tempio degli Scolari"', 279.

We have seen how the *Timaeus* was not just venerated as a philosophical and 'scientific' study of the natural order, but also lauded as a rhetorical work comparable to the works of Cicero and Quintilian.[83] The new geometrical understanding of space and its pictorial representation during the Renaissance helped to re-emphasise Plato's principle of the existence of a 'continued geometric proportion'.[84] At the heart of this relationship is the notion of geometry as simultaneously a rhetorical and pedagogical device that formed a central principle of the *Studia Humanitatis*.

This 'rhetorical' understanding of geometry becomes most apparent in its application to perspective as, for example, in Alberti's ground-breaking treatise on painting, written in both Latin and Tuscan dialect. Comprising three books, the treatise draws upon geometrical principles to build a theoretical framework for visual representation (*costruzione legittima*), but in such a way that *de Pictura* is not so much an instruction manual for artists but an evocation of the unfolding of geometrically constructed space redolent of the *Timaeus*. This centres on the visual pyramid, in which extrinsic, median, and centric rays extend from the observing eye to an imaginary plane. Describing 'extrinsic' rays – those that serve as the outer boundaries of the visual pyramid, the *piramide luminosa* – as elements that 'form an enclosure around the entire surface like a cage', Alberti explains how the interception of these and other rays by intermediate vertical planes gives rise to proportional intervals between their intersections.[85] Accordingly, 'any lesser triangle may be proportional to a greater', given that 'the visual pyramid is made up of triangles'.[86]

Alberti is explicit about the ubiquitous nature of triangles and their proportional relationships within the pyramid of vision indicating how these define the spatial apparatus

[83] The rhetorical attributes of the *Timaeus*, in its original Greek, exercised the mind of Cicero himself through his partial translation, that also provided the basis for humanist enquiry.
[84] Sayre, 'The Multilayered Incoherence of Timaeus' Receptacle', 75.
[85] *Leon Battista Alberti, On Painting*, trans. Cecil Grayson (London: Penguin Books, 1991), 42.
[86] *Alberti, On Painting*, 51.

for visualising depth. He further explains what role median and centric rays play in this visual scaffold. Median rays are all those that occupy the space inside the pyramid of vision, which Alberti likens to a chameleon since they are subject to the nuances of colour within the perspective scaffold: 'from their contact with the surface to the vertex of the pyramid, they are so tinged with the varied colours and lights they find there'.[87] The centric ray is the only ray that meets the picture plane from the observing eye at right angles, and is therefore the most powerful and direct of all the rays, which Alberti calls 'the leader and prince of rays'.[88] The position and distance of the centric ray, according to Alberti, plays a large part in determining sight.

On the basis of these constituent parts – angles and lines – that comprise the 'scaffold' of the pyramid of vision, Alberti provides a step-by-step account of the construction of linear perspective, framed by what he describes as an 'open window', through which the painted scene comes into view. Importantly, Alberti emphasises the anthropomorphism of *costruzione legittima* by positioning the centric point in the frame so that it is no higher above the base-line than a standing figure (three *braccia* high), positioned outside the open window and serving as the proportional matrix for the whole perspective. We see this demonstrated in the way in which Alberti determines the horizontal (*braccio*) divisions on the intersected plane, and in their transposition into a squared 'pavement', on which surface the elements of the pictorial narrative (*historia*) are assembled in relative depth. This arrangement is then 'certified' by the insertion of diagonal lines connecting the corners of the projected square and passing through the corners of the squares comprising the gridded floor.

[Insert Fig. 14.7 here]

[87] *Alberti, On Painting,* 43.
[88] *Alberti, On Painting,* 44.

Fig. 14.7: ‘Distance-point construction’. The final step in Alberti’s account entails drawing diagonal lines across the pavement to demonstrate the ‘correct’ foreshortening of the geometry. Drawing by Manwinder Lall after Joan Gadol.

In explaining the mixture of colours and their tonal variations within the visual pyramid, Alberti identifies an important correspondence:

> My own view about colours, as a painter, is that from the mixture of colours there arises an almost infinite variety of others, but that for painters there are four true genera of colours corresponding to the number of the elements, and from these many species are produced. There is fire-colour, which they call red, and the colour of air which is said to be blue-grey, and the green of water, and the earth is ash-coloured. We see that all the other colours, like jasper and porphyry stone, are made from a mixture.[89]

This description of colours in the visual pyramid clearly alludes to the Timaean Receptacle. It recalls the alignment of the four elements with colour, how these reinforce the proportional relationships inherent in the truncated triangles of the visual pyramid, and by extension the anthropomorphic matrix of the gridded floor. The chain of proportional relationships of elements underlying Plato’s cosmogony is structured, as we know, around triangles that constitute the ‘building blocks’ of four regular solids: tetrahedron (fire); octahedron (air); icosahedron (water); and cube (earth).[90] Whilst the first three geometric forms are comprised of half-equilateral scalene triangles with sides of ratio $1:\sqrt{3}$, the sides of the fourth, the cube, are formed from ‘half-squares’ or isosceles triangles with a ratio of $1:\sqrt{2}$ between side and

[89] *Alberti, On Painting*, 45.
[90] Pl. *Ti.* 67c-68d.

hypotenuse. In contrast, to the 'mutually convertible' geometries of fire, air, and water, earth's cubic geometry stands alone as unique, a status that seems to have drawn much interest in Renaissance architectural theory.[91]

The apparent 'incommensurability' of geometry in the *Timaeus* would have provided a fertile starting point for Alberti's formulation of *perspectiva artificialis*. Alberti's account of the mixture of the four 'elemental' colours within the pyramid of vision also inevitably extended to the overall geometrical arrangement of pictorial space. In addition to Plato's account of colours in the *Timaeus*, another key source for Alberti in this regard would probably have been Calcidius' *Commentary*, where we find a detailed interpretation of the Timaean generation of the world (*De Genitura Mundi*) through triangles, beginning with an explanation of angles in *epipeda* (plane figures).[92] Like Calcidius' account of the existence of a 'single proportional mean' to explain the relationship between two similar triangles, Alberti similarly explains in his step-by-step description of the construction of pictorial space how the insertion of intermediate vertical planes reveals how a 'lesser triangle may be proportional to a greater'.[93]

When Ficino applied the Pythagorean theorem, alongside other theorems derived from Theon of Smyrna and Nicomachus of Jerash, to the half-equilateral scalene with horizontal side of 1, hypotenuse of 2 and perpendicular side of root 3, he identified 'rational square roots' that follow the sequence of isosceles triangles.[94] Although Ficino did not demonstrate this relationship until after Alberti had completed *de Pictura*, the principle of a common 'species' of whole number triangles between the cube and the triangular pyramid, or

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[91] Sayre, 'Multilayered Incoherence', 75.
[92] *On Plato's* Timaeus*: Calcidius*, ed. and trans. John Magee (Cambridge, MA: Harvard University Press, 2016), 133-59.
[93] *Alberti, On Painting*, 51.
[94] Michael J. B. Allen, 'The Ficinian Timaeus and Renaissance Science', in Reydams-Schils (ed.), *Timaeus as Cultural Icon*, 238-50, at 241; *id.*, *Nuptial Arithmetic: Marsilio Ficino's Commentary on the Fatal Number in Book VIII of Plato's Republic* (Berkeley: University of California Press, 1994), 56-8. Derived from Pl. *Resp.* 8, 546a-d.

tetrahedron, provides in many ways the basis for understanding the meaning of the pyramid of vision in a Renaissance perspective. This geometry has underpinned optical theories since antiquity, but the degree to which medieval theories of optics, promulgated by Ibn Al-Haytham (Alhazen), Roger Bacon, John Peckham, Vitello (Witelo), and others, influenced the invention of linear perspective has been much debated.[95] It is clear, however, that relationships between *perspectiva naturalis* and *perspectiva artificialis* during the fifteenth and early sixteenth centuries were influenced by the revival of 'Pythagoreanism', specifically in the cosmological significance attached to whole numbers.[96] In the *Timaeus*, we recall, Plato emphasised the importance of vision when he observed the numerical and proportional relationships between heavenly bodies.

This 'Pythagorean' revival can initially be traced to the earlier writings of Salutati, whose *De laboribus Herculis* (The Labours of Hercules) shows his veneration for the sage as a paragon of the virtuous life.[97] Such veneration deepened during the Quattrocento, in the work of Bruni, Lorenzo Valla, and Poggio, and served as a critical support to Timaean studies. It also formed the basis of architectural proportional systems and underpinned a new theology of 'measure' in humanistic thought in the late fifteenth and early sixteenth centuries, particularly in the works of Ficino, Pico della Mirandola and Giles of Viterbo. Alberti's attempt to align the proportions of the human body with the 'illusion' of spatial depth was taken a step further by Leonardo da Vinci, who sought to conceive an optimum perspectival arrangement by using whole number relationships to calibrate visual depth.[98]

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[95] Smith, *From Sight to Light*, Chapter 7. David C. Lindberg, 'Alhazen's Theory of Vision and Its Reception in the West', *Isis* 58 (1967), 321-41.
[96] Christiane L. Joost-Gaugier, *Pythagoras and Renaissance Europe: Finding Heaven* (Cambridge: Cambridge University Press, 2009).
[97] Joost-Gaugier, *Pythagoras and Renaissance Europe*, 19-23.
[98] Nicholas Temple, *Disclosing Horizons: Architecture, Perspective and Redemptive Space* (London: Routledge, 2007), 43-4. As Padovan, *Proportion*, 214 states: 'the key to the Renaissance discovery of systematic laws of perspective was that these laws are themselves ruled by proportion. The proportions that Renaissance architects applied to the measures of their buildings were seen in perspective.'

It seems clear therefore that the square pyramid of vision, when applied to linear perspective, unifies the previously incommensurable geometries of the triangular pyramid, or tetrahedron, of fire and light and the cube, of earth. The 'picture plane' helps to bring together the 'fire in the eye' that is vision and the gridded pavement of the ideal terrestrial city. Calcidius provides a useful point of departure in this transformation:

> For according to Plato himself, fire is claimed to be pyramidical in form and shape, i.e., its extension is in the manner of a pyramid, whereas earth is a cube, and these shapes share no likeness with one another, since they do not consist of equal angles (for every cube consists of right angles, and so earth, being cubic in shape, necessarily has right angles, whereas the angles of a pyramid are more acute at the tip); … If two other solids are to bind the discrete bodies by their intercalation, then on the current supposition the continuous bond will be impeded ...[99]

Calcidius goes on to highlight how Plato addressed this disparity by explaining that 'similitude is to be sought not only in forms and shapes but also in potencies and qualities'.[100] He demonstrates this by explaining geometry 'according to the ratio of a continuous proportion: as fire is to air so air is to water and, finally, water to earth; and conversely ...'.[101] This relationship which follows Plato's assertion (*Timaeus* 31c 32a), quoted by Calcidius, that 'among three things, whether numbers, masses, or powers, the middle is to the last as the first to the middle', provides a clue as to how Alberti may have understood in Timaean terms the geometric and symbolic significance of the 'hybrid' square pyramid of vision.[102] By combining and merging the elements of fire ('fire in the eye') and earth in this hybrid

[99] *On Plato's* Timaeus, tr. Magee, 149-51.
[100] *On Plato's* Timaeus, tr. Magee, 151.
[101] Magee, 153-4.
[102] Magee, 151.

geometry, the transmission of the median and centric rays to the terrestrial gridded pavement conveys a cosmological, optical relationship through the medium of the squared perspectival window: the third, intermediate property in this relationship, which appropriates, or transforms, the former, the projecting rays, to achieve the latter, pictorial space.

Alberti had a particular interest in the nature of light and the element of fire, having written a passage on the subject (*De Igne*) in a fragment from a previously unknown treatise on the casting of statues.[103] The fragment uses references from Calcidius' *Commentary*, although it is possible that Alberti also referred to the original text of the *Timaeus*, given his acquaintance with the Greek language and his association with Greek humanist scholars.[104] Alberti departs, however, from the Timaean narrative in one important respect: by dismantling the Platonic view that fire possesses something transcendent and divine, and in the process rejecting the principle of elemental spheres.[105] It is perhaps in Alberti's mathematical resolution of pictorial space in relation to the 'fire in the eye' that we see this departure from Platonic principles most clearly through the formulation of a 'reconciliatory' geometry: the gridded pavement, and its certified diagonal registering the hypotenuse of two isosceles triangles. This method effectively represents the footprint of the Timaean cube in perspective, which 'anchors' the visual pyramid terrestrially. We see this demonstrated most

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[103] 'De igne ignisque natura ac de multis quae per ignem efficiuntur', MS. Ottob. lat. 1870, in Franco Bacchelli, 'Un frammento Inedito di Leon Battista Alberti', *Noctua: La tradizione filosofica dall'antico al moderno* 7.1 (Feb 2020), 1-67. The treatise also contains the *Dialogus de circuli quadratura*, referred to earlier, written by Nicholas of Cusa in 1457 and dedicated to Paolo dal Pozzo Toscanelli, 3.

[104] Calcidius, 10. *De Visu*, 247. I am grateful to Cecilia Panti for pointing out the references from Calcidius. Although the extent of Alberti's knowledge of Greek is unknown, he seems to have had sufficient knowledge 'to have read at least parts of Herodotus in the original'; however, he was clearly less expert than Guarino da Verona, and, despite his acquaintance with many Greek authors, there is no definite evidence that he had read Plato in the original: Martin McLaughlin, 'Humanist Translations and Rewritings: Lucian's Encomium of the Fly between Guarino and Alberti', in Giancarlo Abbamonte and Stephen Harrison (eds.), *Making and Rethinking the Renaissance. Between Greek and Latin in 15th-16th Century Europe* (Berlin: De Gruyter Publishers, 2019), 95-108, at 107.

[105] Bacchelli, 'Un frammento Inedito', 11-16 suggests that Alberti knew about the criticisms of Valla's anti-Aristotelian view that there is not a 'sphere of fire' below that of the Moon and his alternative view that fire is neither a divine element nor a cosmological/intellectual principle (*ignis intelligibilis*). He argues that Alberti was inspired by Theophrastus's *De natura ignis* and Dino del Garbo's similar rejection of the theory of the elemental spheres. Charles Trinkaus, 'Lorenzo Valla's Anti-Aristotelian Natural Philosophy', *I Tatti Studies in the Italian Renaissance* 5 (1993), 279-325.

explicitly in a woodcut in Book Two of Sebastiano Serlio's treatise *L'Architettura*, where a squared plan of a 'four-way' arch resembling a Janus Quadrifrons is projected perspectivally onto a gridded pavement with certified diagonal lines.[106]

[Insert Fig. 14.8 here]

Sebastiano Serlio (1475-1554). Perspective construction of a four-way arch ('Janus Quadrifrons'), from *Sebastiani Serlii Bononiensis de architectura libri quinque*…(Venetiis: Apud Franciscum de Franciscis Senensem, & Joannem Chriegher, 1569), 'Liber Secundus', p35., RIBA Collections.

It is, however, through the merging of the four colours and their changing hues, in the act of painting within the perspective frame, that the four cosmic elements of the *Timaeus* are brought into play within the narrative scene (*historia*) that combines the painterly features of terrain, horizon, sky, cloud, and water.

5 Conclusion

In this investigation, I have attempted to demonstrate how the *Timaeus* was received and understood in relation to architecture and perspective in early fifteenth-century Florence. In the Early Renaissance, the revival of Platonism coincided with the rediscovery of classical antiquity through antiquarian and humanistic activities and the significant developments in architecture and the visual arts. This is exemplified in Brunelleschi's completion of the dome of Florence Cathedral and Alberti's treatise on painting. The *Timaeus* provided a fertile

[106] Sebastiano Serlio, *Tutte l'opere d'architettura et prospettiva* (ca. 1584), Book Four, 24, Illustration D4.

philosophical source for envisioning analogous relationships between these different initiatives, through the agency of the creation myths underpinning number and geometry. What is represented in the *historia* of Alberti's *costruzione legittim*a becomes paradigmatic, in its thematic content and pictorial arrangement, of the geometrical and proportional systems applied in the architecture and urban spaces of the 'lived' city of Florence. Optical 'measure' in *perspectiva artificialis* effectively mirrors *lineamenta* and Platonic geometries found in building. In the light of the renewed interest in the *Timaeus* during this time, and the revival of Platonism in general, Alberti's treatment of this tradition (against the backdrop of civic humanism) offered a brief interlude of 'embodied space' before the encroachment of scientific thinking in the modern world.

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