

RESEARCH ARTICLE

Early Modern Netherlandish Artists on Proportion in Architecture, or 'de questien der Simmetrien met redene der Geometrien'

Krista De Jonge*

The question of geometrical and/or *versus* arithmetical proportions remains unresolved insofar as Netherlandish Early Modern architectural production is concerned. A newly discovered manuscript book on the orders that can be attributed to a Netherlandish artist active in the 1530s confirms the need for a less antithetical interpretation of Renaissance proportional systems in northern European architecture than has been common in the scholarship to date. Beginning in the 1530s, a geometrical way of expressing both geometrical and arithmetical proportions was developed, connecting both masters of the "antique" and of the "modern" through one notation system understandable by all. This article traces its offshoots until the seventeenth century.

The early modern Low Countries occupy a peculiar position in the history of proportion in architecture. Situated at the crossroads between Italy, the Iberian world, Germany, and Northern Europe, they offer evidence of original interaction with the new theory of the column orders coming out of Italy already in the earliest decades of the sixteenth century, which defies inclusion into the prevailing views on the evolution of proportional systems as defined by Panofsky and Wittkower. Our case studies will thus fit in well with the critical notes recent scholarship has added to the antithetical view on 'Gothic' versus 'Renaissance' (see Introduction to this issue of *Architectural Histories*, and also Chatenet et al. 2011, and Kavalier 2012). At the time two different repertoires of architectural ornament were present on the market on equal terms, the 'antique' imported from Italy, and the newest 'Renaissance Gothic', consistently called 'modern' in contemporary Netherlandish sources (Kavalier 2000; De Jonge 2007a). Not only architects but also many painters, such as Jan Gossaert called Mabuse, were well-versed in both languages, and used them with fluency as the occasion – and the patron – demanded (Mensger 2002; Kavalier 2010). Pluralism of style was the prevailing characteristic of the leading art collections of the period, such as Regent Margaret of Austria's in her residence in Mechelen (Eichberger 2002; Eichberger 2005).

The port of Antwerp will play a central role in our essay. The first foreign-language translation of Sebastiano Serlio's *Quarto libro*, for instance, came out of the artistic and humanistic milieu of the city. It was published in Flemish in 1539 by the painter Pieter Coecke van Aelst in Antwerp,

with the help of Cornelis De Schrijver, alias Scribonius, alias Grapheus, the learned town clerk (Coecke van Aelst 1539b).¹ Most probably at the insistence of Grapheus, the city magistrate had subsidized Coecke's rent in 1542 and 1543 when he was preparing the costly first French and German translations of the book (Coecke van Aelst 1542a; Coecke van Aelst 1542b; Van der Stock 1998–1999: 65). Coecke had first-hand experience of the antiquities in northern Italy near Venice, and of Constantinople, which he visited in 1533; whether or not he knew Rome is still a point of debate (Marlier 1966: 55–72; Necipoğlu 1989: 419–420; Born 2008). Coecke was also a court artist, one of only three to bear the newly invented title of *artiste de l'empereur* (artist to the emperor) during Charles V's reign, distinguishing the 'artist' – self-fashioned as an intellectual, a master of the art of *disegno* – from the common craftsman who worked with his hands (De Jonge 2010b).² Artistic practice, in particular the practice of architecture, had been slowly changing since the start of the urban building boom of the fifteenth century, which was entirely Gothic in style (Hurx 2012: 32–65 in particular; see also Coomans 2011), but the process accelerated in the early sixteenth century, which brought from Italy a new style and renewed, intensified contact with antiquity. Antwerp's artistic vanguard played a major role in diffusing the artist's new image throughout the Low Countries, thus contributing greatly to the social emancipation of architecture and its practitioners.³

Our source material is not taken from actual construction practice through the careful survey of existing buildings (e.g., Cohen 2008), but consists of texts, prints and drawings which were published and generally available on the market of the time. Written early modern Netherlandish sources on designing architecture are in fact extremely rare, as are drawings and prints offering

* Leuven University, Belgium
Krista.DeJonge@asro.kuleuven.be

evidence of proportion and proportioning systems; moreover, hardly any proportional analysis has to date been carried out on Netherlandish buildings of the period.⁴ As a consequence, we will have to define carefully what their audience was, what array of sources they drew upon on the international plane, and what relationship our findings could possibly bear to actual construction. It is indeed our contention that the surviving material offers a glimpse of the discourse current with the intellectual and artistic elite of the time, rather than any measurable connection with architectural practice.⁵

Written discourse: On the importance of *symmetria*

The importance of proper proportioning appears in the Netherlandish discourse on the arts from the early decades of the sixteenth century. Its main conduit is Vitruvius: at the time the humanist élite, who read Vitruvius as they would any other Latin text, helped to introduce craftsmen to this notoriously obscure source, which described an architecture and building technology entirely disconnected from contemporary practice. The Vitruvian text had, of course, never been forgotten, but throughout the Middle Ages its impact on the stonemason's trade, as Joseph Rykwert has argued, was much less significant than that of Euclidian geometry (Rykwert 1982: 76–79).⁶ In the same milieu, Alberti's *De re aedificatoria* was read as shown, for instance, in the work of the aforementioned Cornelis Grapheus. In 1528 Cornelis published Pomponius Gauricus' 1504 treatise *De sculptura* (Gaurico 1528) at his brother Joannes (Jan) Grapheus' printing house in Antwerp (Prims 1938: 172–190).⁷ In the introduction he quotes Vitruvius and Alberti, and expresses the hope that the passages on *symmetria* or proportioning will be useful to sculptors, painters, and architects alike, since *symmetria* feeds all the arts ('symmetriam ... omnium deniq[ue] artificiorum nutricem'; Gaurico 1528: fol. a2 verso–a3 recto).⁸

A contemporary source, Albrecht Dürer's *Vier Bücher von Menschlicher Proportion* (*On Human Proportion*), which appeared in Nuremberg in the year of his death (Dürer 1528), was certainly known in Antwerp, where the painter had known a resounding success at his visit in 1520–1521 (*Albrecht Dürer in de Nederlanden* 1977; Plard 1990). The German artist had been working on the manuscript for at least seven years before it was published. The treatise should of course be taken together with its preceding manual on geometry, the *Underweysung der messung, mit dem zirckel unn richtscheyt in Linien ebnen unnd gantzen corporen* (Dürer 1525). Dürer had quickly published the latter book because he realized that his work on human proportion otherwise could not be understood properly ('nit gruentlych verstanden mag werdenn'). In both works he incorporated Vitruvius, Alberti and of course Gauricus, but also the teachings received from Luca Pacioli in Venice together with empirical research. Thus he developed original methods of representation and became one of the pioneers of descriptive geometry north of the Alps; the well-known humanist Konrad Celtis lauded his mastery of *symmetria* in a learned epigram

(Haffner 2006: 153; for an overview with older literature, see Hemfort 1988; see also Wuttke 1967: 321, 324). The term *Proportion* in the title of the treatise may be seen as a significant, and conscious, mark of modernism, contrasting with the homegrown word *Messung* (measurement) in the manual. It should also be noted that his well-known schemes on the proportions of the human figure presuppose a fairly high level of numeracy, as they show difficult fractions in Arabic numerals.⁹ On this point Dürer in fact connected with a centuries-old tradition of 'arithmetical geometry'. As Peter Kidson has stressed, all through the Middle Ages, in continuation of antiquity, mathematicians discussed geometrical proportions in arithmetical terms, using fairly accurate approximations of surds such as $\sqrt{2}$ and $\sqrt{3}$ (Kidson 2008: 19–20).¹⁰ This mode of expression cannot have remained entirely unknown to building masters either, even before Rodrigo Gil de Hontañón wrote down his precepts for the proportioning of the buttress in mid-sixteenth century Spain, using the square root as a novelty.¹¹

There are correct principles and erroneous ones, Coecke stresses in his publications, first and foremost in the first antique-inspired treatise to appear in the Flemish language, *Die Inventie der colommen*, published in Antwerp in 1539 ('On the invention, or design, of columns'; Schéle 1962).¹² Here a neologism for the term *symmetria*, or 'simmetrie', is introduced for the first time in the Netherlandish language (Coecke van Aelst 1539a: fol. a 3 verso).¹³ *Die Inventie* excerpts Vitruvius almost exclusively on this point, but the theme returns in Coecke's translation of Serlio's *Book I on Geometry*, published posthumously in 1553 by his wife Mayken Verhulst in Antwerp (Coecke van Aelst 1553). While such a book might be deemed superfluous, Coecke says to the reader, it is sorely needed:

Most of our artisans content themselves with the outer appearance and do not pay any attention to the correct proportioning (*simmetrien*) of the work; for the discerning art lover the result looks very confusing, and that is certainly a pity in works which as to their finishing, might even be preferred to Italian ones. (Coecke van Aelst 1553: fol. A i verso; all translations by the author)¹⁴

This address has Dürerian overtones: In his *Underweysung der messung*, Dürer had similarly written that the art of geometry constituted the true basis of painting; many painters which had not learnt this art made errors out of ignorance.¹⁵ Is this normative mindset a sign of the times? It is worth noting here that in his *Unterweysung* for his son Moritz (1516), Lorenz Lechler of Heidelberg emphasizes a similar difference between the mason who does not master the art ('der der kunst nicht erfahren ist') and those artists who know and understand ('khunstler, die es verstehn und wissen'), who constitute the true audience of his treatise, which is known through several manuscript copies (Seeliger-Zeiss 1967; Seeliger-Zeiss 1982; Egidy 1988). Even if its vocabulary of forms reflects the southern German Gothic of the late fifteenth century, Lechler's

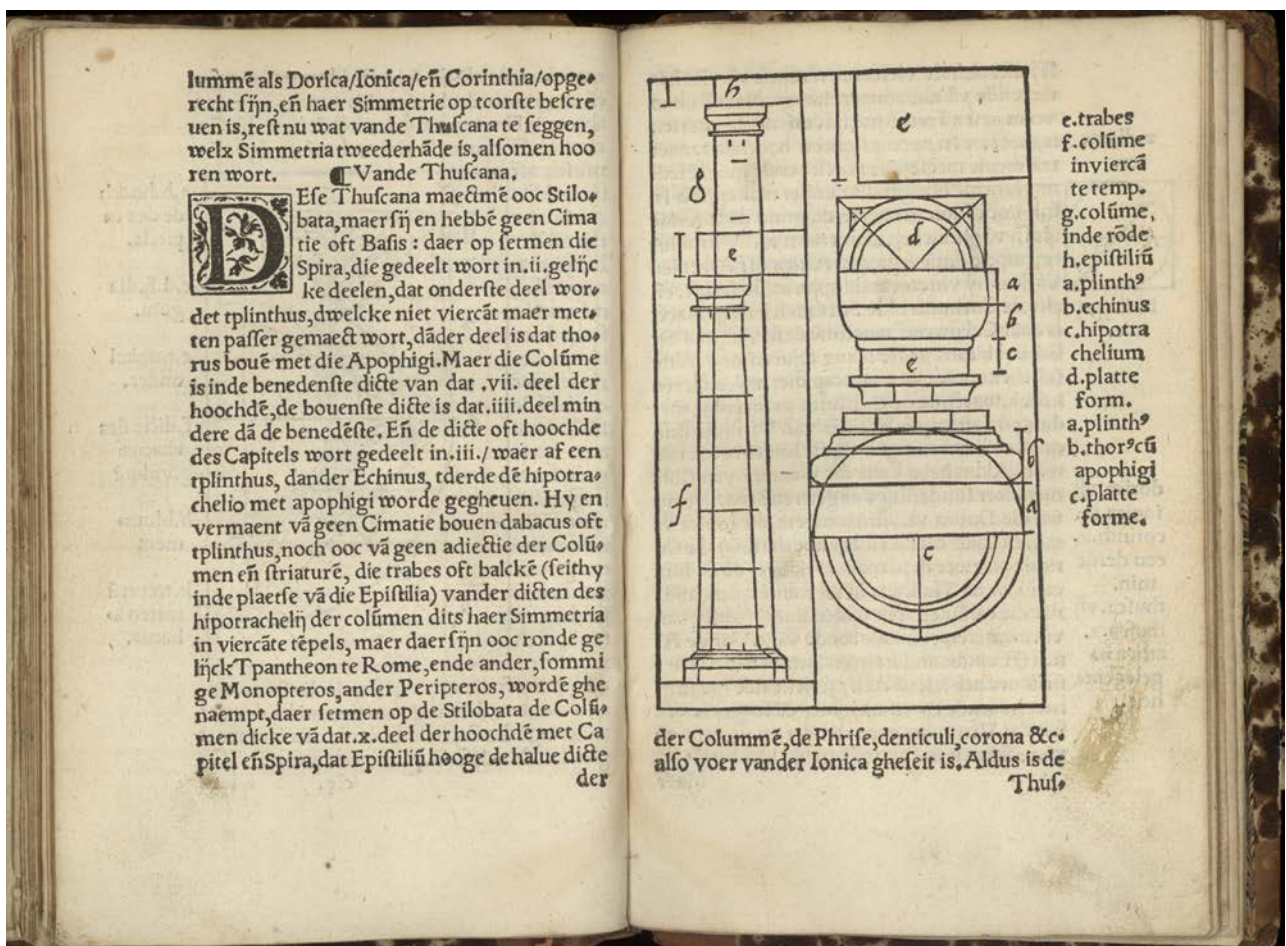


Fig. 1: Pieter Coecke van Aelst, *Die Inventie der colommen* (Antwerp, 1539), fol. c 6 recto: On the proportioning of Tuscan columns. Ghent, University Library.

Unterweisung, it could thus be argued, is part of the same new literary category as Dürer's and Coecke's treatises, which are considered as belonging to the Renaissance. At the time, Lechler was architect to the Palatine court in Heidelberg, a flourishing center for the study of (Gallo-) Roman antiquity since the 1480s. Indeed, amongst its connections we find the then owner of the famous Carolingian Vitruvius manuscript now in Sélestat/Schlettstadt, Johann von Dalberg, bishop of Worms.¹⁶ We are similarly reminded of the fact that the well-known booklet on Gothic finials published by Mathes Roriczer in Regensburg in 1486 (*Büchlein von der Fialen Gerechtigkeit* 1486) at the instigation of Wilhelm von Reichenau, the learned bishop of Eichstatt and 'lover of geometry' (in Roriczer's words), was actually produced by the same extended intellectual network (Günther 1988a; Günther 1988b; Günther 2003: 61–65).¹⁷ Forty years later, Dürer dedicated his treatise on geometry to Reichenau's godson, the humanist Willibald Pirckheimer, who was also his friend.

Demonstration by image: Pieter Coecke van Aelst

The proportioning system for columns that Coecke presents in his 1539 *Inventie* is primarily based on a critical but faithful reading of Vitruvius in the Cesariano edition (he in fact contrasts the principles declared in the

Cesariano text and those underlying the images), and to a lesser degree of Pliny. Its two-fold way of presenting the column proportions, however, may be called innovative. Coecke adopts a very simple way of showing the basic proportions of the column, which has no exact counterpart in the Cesariano Vitruvius edition, nor in Serlio's Book IV, which he translated into Flemish in the same year (Coecke van Aelst 1539a: fol. b 5 recto: on the proportioning of the Doric and Ionic column; fol. c 2 recto: on the entasis of the column; fol. c 6 recto: on the proportioning of the Tuscan column, see **Figure 1**).

It must indeed be stressed that the *Inventie* shows no sign of Serlio whatsoever.¹⁸ Horizontal dividing lines and notches scale each column shaft in the plate, which compares the squat Doric column and the Ionic, and likewise in the figure showing both Tuscan variants. Small relative scales consisting of notched verticals accompanied by numerals indicating the number of subdivisions accompany the Doric and Ionic bases, and a similar device is used for explaining the main proportions of the Corinthian capital (Coecke van Aelst 1539a: fol. c 5 recto; see **Figure 2**).

Coecke has obviously been inspired by Dürer, who systematically used numbered notches in his 1525 *Unterweisung* to illustrate graphically the subdivision of the antique pedestal, column base and different types of pedestals (Dürer 1525, Book III; see, for instance, fol. g v

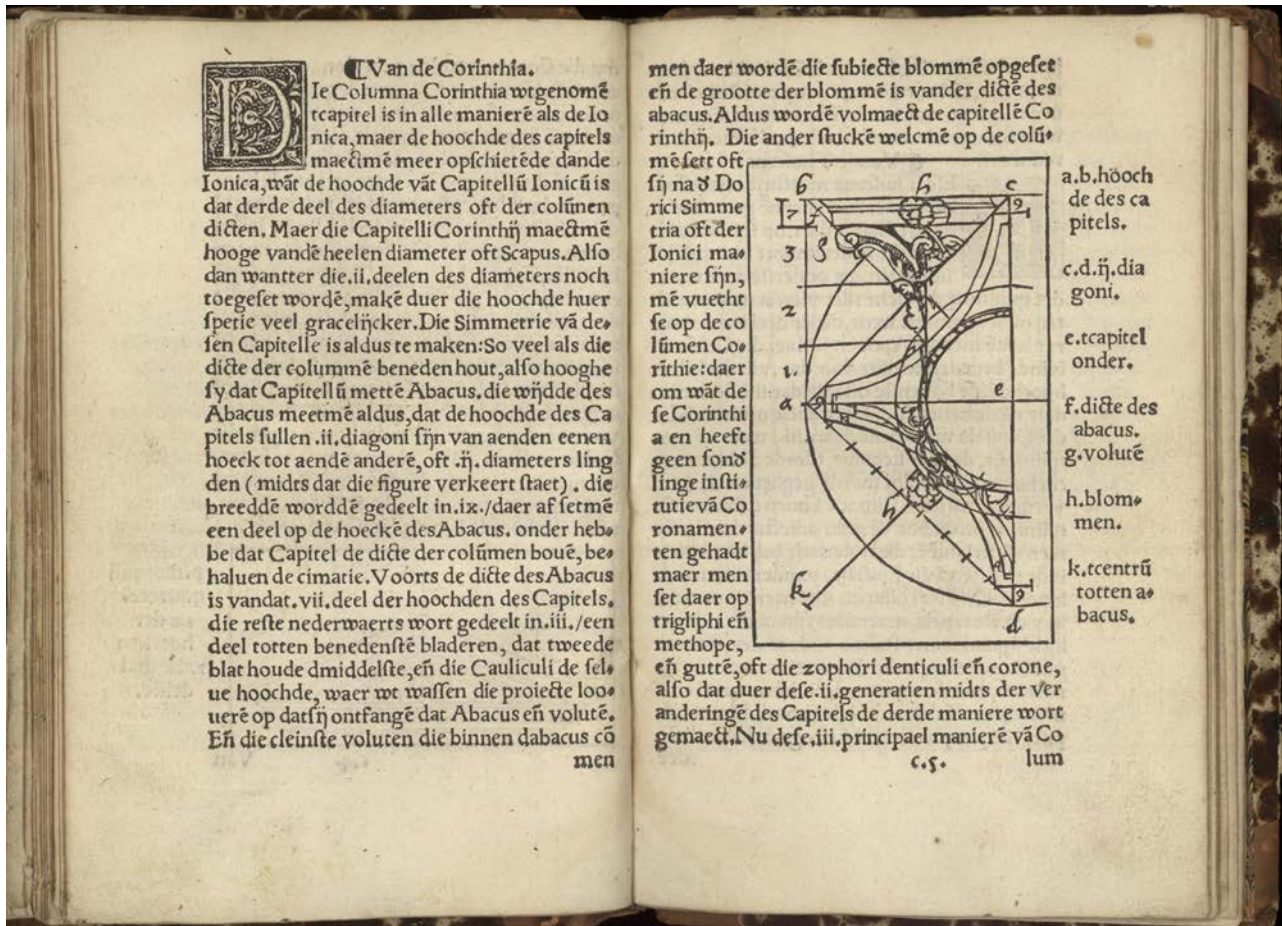


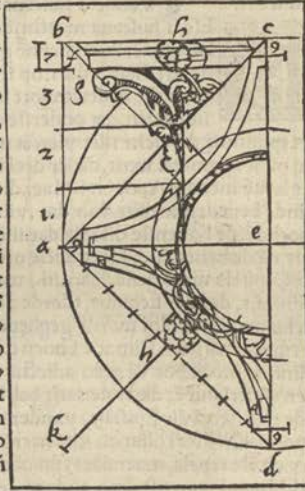
Fig. 2: Pieter Coecke van Aelst, *Die Inventie der colommen* (Antwerp, 1539), fol. c 5 recto: Corinthian capital. Ghent, University Library.

recto and verso, g vi verso, and h i recto). But Coecke's horizontal subdivisions of the column shaft are not numbered; they rather resemble the horizontal dividing lines of the human figures in Dürer's 1528 *On Human Proportion*. On this point a parallel may also be drawn with Cesariano's illustration of atria and peristylia with various proportions, where notches and numerals are used to render proportional relationships immediately visible to the eye; and with the unnecessarily complicated, and unworkable, horizontal subdivisions and grid lines with which Cesariano renders his Doric and Ionic capitals and bases (Cesariano 1521: Book VI, fol. 98 recto, and Book V, fol. 47 verso, respectively).¹⁹

In the same Vitruvian booklet of 1539, the image showing the construction of the (Doric) pedestal mixes a linear scale with a demonstration of the art of the compasses (Coecke van Aelst 1539a: fol. b 7 recto, see **Figure 3**, with text on fol. b 6 verso, see below).

If we take the text into account, the result seems ambiguous. On the one hand, while the general structure can be taken from the image, the proportioning of certain details can be guessed at, but only understood completely through reading the accompanying description on the facing page (b and c each equal a divided by 4, as does d, while e is one third of a, and f one sixth). Instead of Dürer's numbered segments, Coecke uses letters but without indicating the relationship between different quantities,

men daer wordē die subiecte blomme opgefet en de grootte der blomme is vander dicte des abacus. Aldus wordē volmaect de capitellē Corinthij. Die ander stuckē welcme op de colūmē set of sijn na d Dorici Simmetria of der Ionici maniere sijn, mē vuecht se op de colūmen Corinthie: daer om wāt de se Corinthia en heeft geen sondlinge institutievā Coronamen ten gehadt maer men set daer op triglyphi en methope, en guttē, of die zophori denticuli en corone, also dat duer dese .ii. generatien midts der veranderingē des Capitels de derde maniere wort gemaect. Nu dese .iii. principael maniere vā Colūmen



a. b. hōochde des capitels.
c. d. h. diameter.
e. t. capitellē onder.
f. dicte des abacus.
g. volutē
h. blommen.
k. t. centrū totten abacus.

c. s. lum

much like Cesariano.²⁰ The image is more autonomous than Serlio's illustrations in Book IV, for instance, but not completely (Carpo 2003: 452–453; see also Rosenfeld 1989, and Hart 1998). Still, even without the text the image is still much clearer than the Cesariano gloss this passage is generally based on (Cesariano 1521: Book IV, fol. 66; image on fol. 65 verso).

On the other hand, the text takes the reader step by step through its construction, or its *Simmetria*, as Coecke explicitly says, and can indeed be understood without the accompanying image, if we know what a pedestal looks like.

The proportion [of the pedestal] is made thus. To start with, the plinth at the bottom, according to Vitruvius, will be of two column diameters' width, and its height, says Cesariano, will measure three column diameters. The lower width on the ground will be subdivided into eight; upon the central six parts the die [dado] will be erected, and the remaining two parts are left to the projections. The height of the plinth corresponds with one part, as does the curvature of the base against the *pluteum* or die. In the case of a Doric order, the upper cornice shall be as wide and high, just like the frieze cut into triglyphs and metopes, including *tenia* and *guttæ*. Once this is done, one can place the column base, as wide as the die, and so the proportioning is

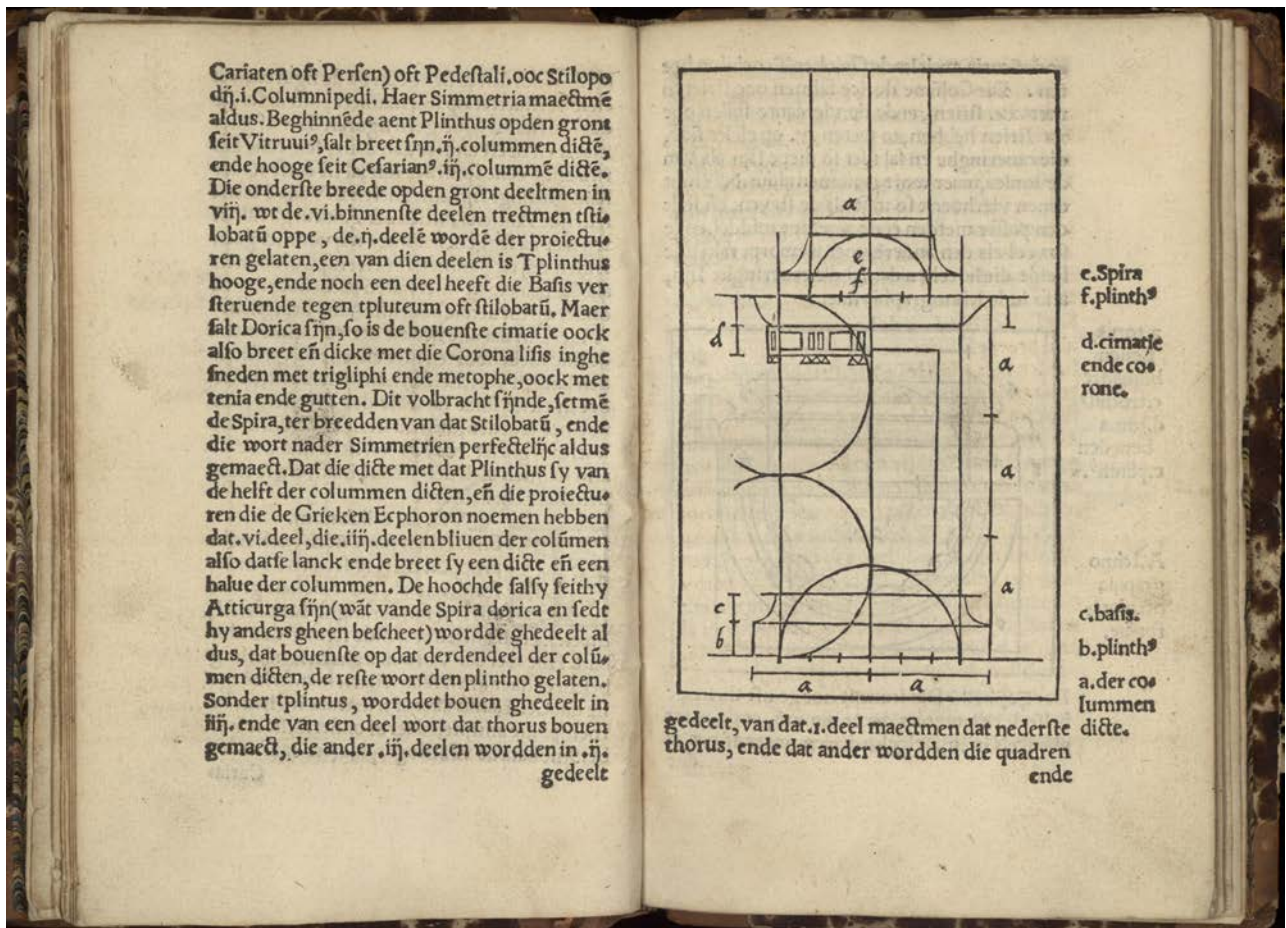


Fig. 3: Pieter Coecke van Aelst, *Die Inventie der colommen* (Antwerp, 1539), fol. b 7 recto: (Doric) pedestal. Ghent, University Library.

complete. Its height together with that of the [column] plinth equals half the column diameter; and the projecting parts that the Greeks call *Ecphoron* each take up one sixth of the total width [of the base, equaling that of the die], which is one and a half times the diameter of the column, leaving four parts for the column shaft. (Coecke van Aelst 1539a: fol. b 6 verso).²¹

In modular terms, the total width of the pedestal at its base is two times the column diameter ($2a$), to be subdivided into eight parts. Vertical plumb lines starting from the points at one eighth and at seven eighths of this base line give us the width of the die of the pedestal, the height of which is three times the column width ($3a$). At the base, the plinth of the pedestal thus projects one eighth of its width or one fourth of a at each side; its height is also one eighth of the base line. The curved transition between plinth and die is also one eighth in height and width. A similar height and projection is given to the pedestal's crowning cornice, etc. If only Coecke had expressed the values of b , c , d , etc., in multiples of his module a – which he could easily have done without having need of advanced mathematical knowledge, because the relations can all be expressed very simply – this image could have been considered a direct precursor of Vignola's numerical representation of the proportions of the column (Carpo

2003: 455–456). As it is, in this case the letters refer to different steps in the procedure and not to an algebraic value. Completely numbered presentations of the column elements were available on the market (and, it can be surmised, also in Antwerp libraries),²² but they do not seem to have been taken into account by Coecke. Print series such as the ones produced by G.A., the Master with the Caltrap, c. 1535 and by Jacques Prévost (?), Master P.S., in 1537 indeed show antique bases, capitals, and entablatures with measurements expressed in *oncie* (inches) and Roman *palmi* (Zerner 1988; see also Waters 2012).

The necessary step of abstraction, however, is still a few decades away (Fig. 4).

The inspiration for this procedure might have been found in Alberti's description of the Attic base, which is in fact an algorithm.²³ Alberti was known and read by Coecke's mentor Grapheus, as we have seen. But more than that, it is indeed suggestive that Coecke pioneered the first correct graphical illustration ever published of Alberti's iterative construction of the Attic base (see Figure 5).

The height [of the base] will be in the Attic manner, as he [Vitruvius] calls it (because he does not say anything about the Doric base). The plinth will be one third larger than the column diameter. [Equal to half the column width, the height] will be subdivi-

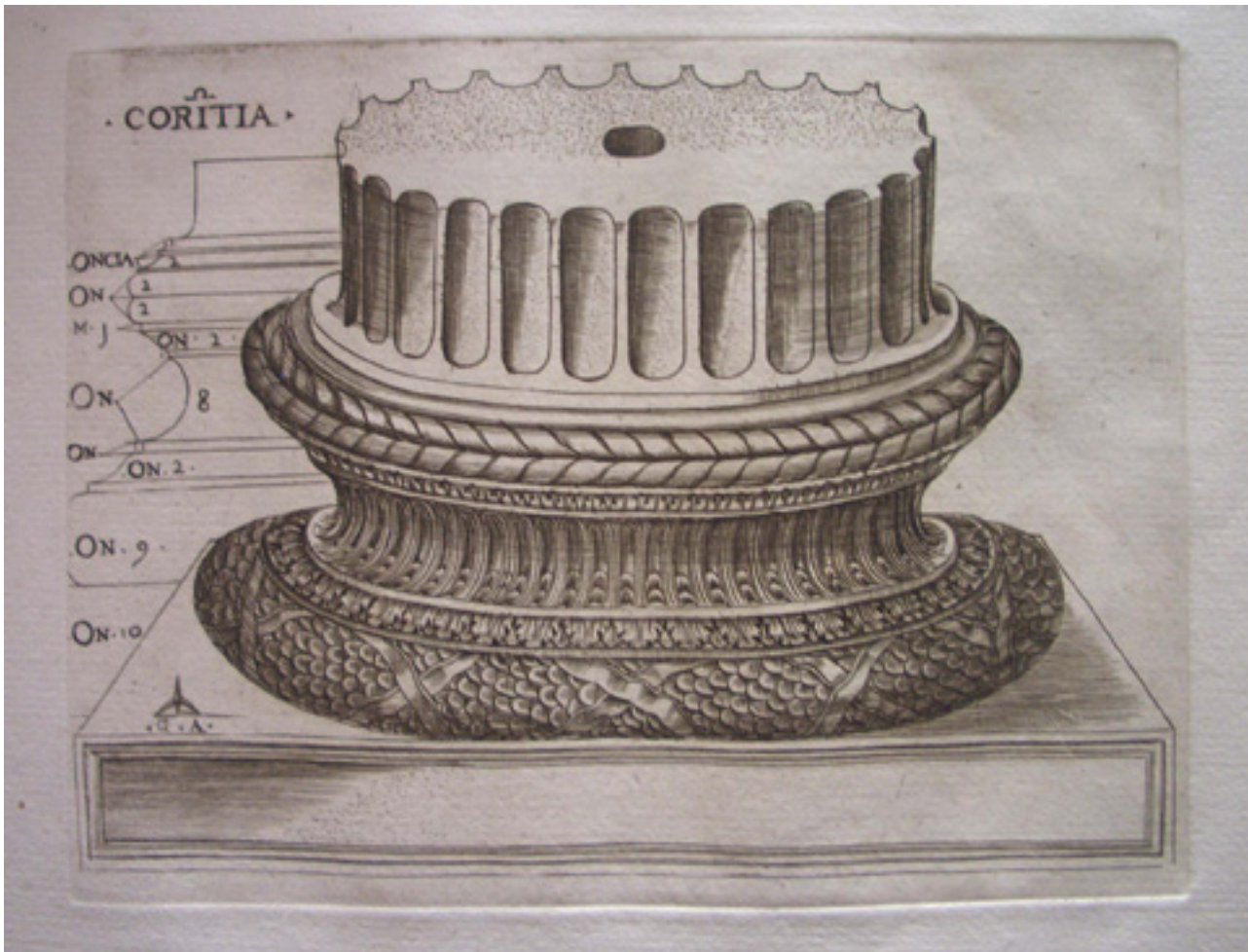


Fig. 4: Master G. A. with the Caltrop, antique base, engraving, c. 1535. Private collection.

vided into three, one part left to the plinth. Leaving aside the plinth, the upper part is subdivided into four, one part for the upper torus; the other three parts are divided into two, one part for the lower torus, and the other for the fillets and *Scotia*, which the Greeks call *Trochilon*. (Coecke van Aelst 1539a: fol. b 6 verso–fol. b 7 verso)²⁴

This plate mixes numbers and letters in a much clearer way than the image of the pedestal. Numbered segments show the proportioning, and the significance of the letters can be deduced from the accompanying caption. As in the image of the pedestal (**Fig. 3**) they denote the different parts of the base, albeit not in the order of proportioning set out in the text.

Dürer might be considered an intermediary phase. In his 1525 *Underweysung* he demonstrated the construction of a vaguely antique column base in a drawing that shows the general subdivision of the height of the base with a notched and numbered line on the right (Dürer 1525: fol. h iij verso) (**Fig. 6**). However, all the details explaining the positions of the defining horizontals and verticals must be taken from the text:

First take a rectangle three times as long as it is high,²⁵ which is also three times as high as the reglet at the lower end of the column shaft; draw

the horizontal projection lines and designate them with letters, the upper one being a and the lower one b, and divide them into three with lines c and d. Then subdivide ac into two, which gives us ae, and subdivide that with four points into five. The upper part corresponds with line f. Then subdivide ec with three points into four, the lower giving us line g, and subdivide eg with three points into four, the upper giving us line h. Next subdivide db with five points into six and cut off the lower two parts with line i and the upper part with line k. Now that we have the horizontal subdivisions, we have to draw in the verticals ending these compartments, [symmetrically] at both ends. The outer edge is defined by line l and the inner one, tangential to the edge of the lower reglet of the shaft, is m. Now subdivide lm with a line n in two parts; this line cuts across c and d defining the middle width of the base. Next subdivide nm with a line o in two parts, so that between e and f a torus or ring can be drawn, that ends at o. But halfway between o and m you should draw a line p from a to f, ending the fillet above the torus, and similarly also the fillet below between e and h. Next divide no into two with a line g [sic] to circumscribe the fillet between gc under the scotia between h and g, whose inner diameter ends at line m. Next draw

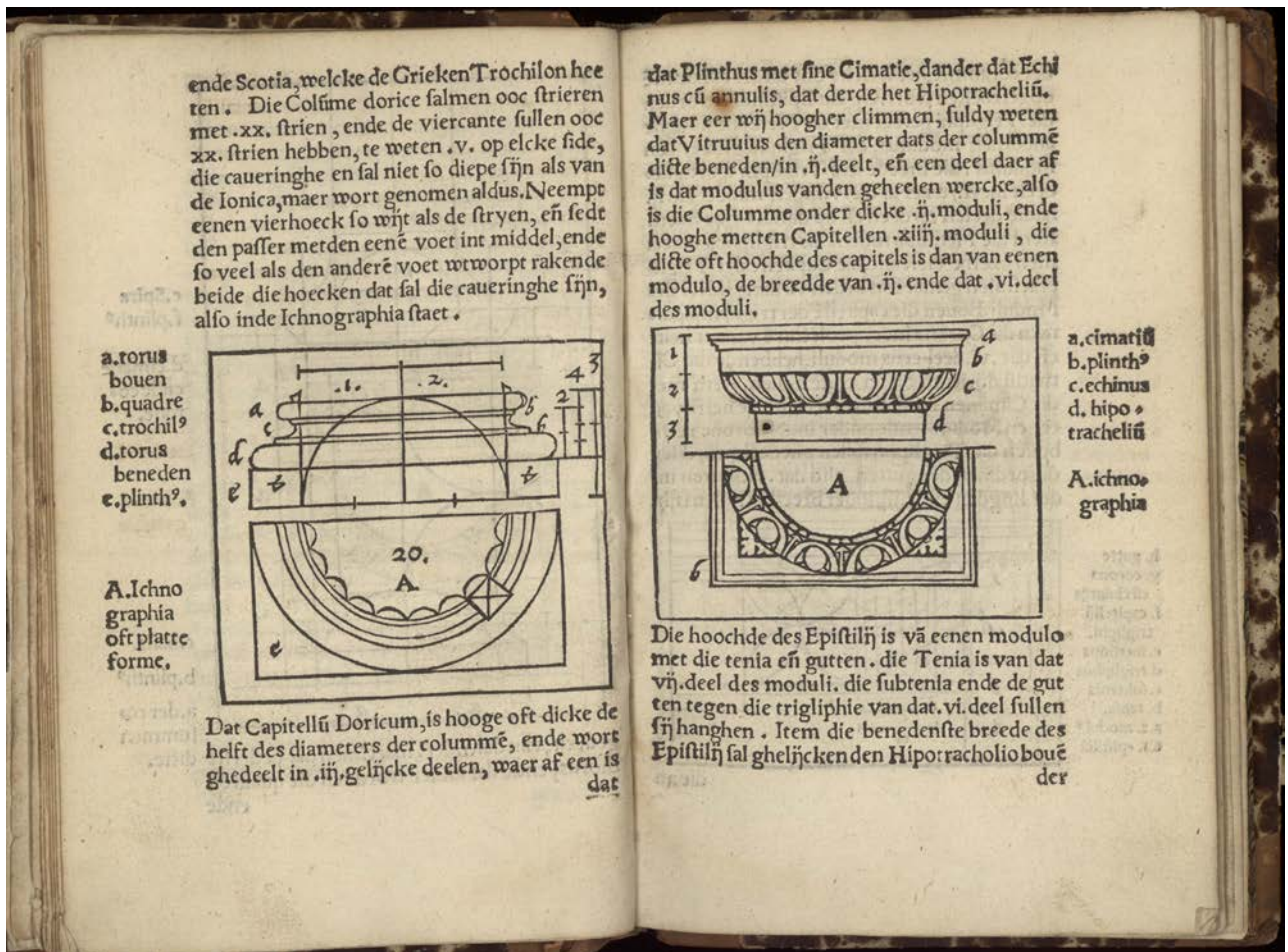


Fig. 5: Pieter Coecke van Aelst, *Die Inventie der colommen* (Antwerp, 1539), fol. b 7 verso: Attic base. Ghent, University Library.

the fillet between d and k staying inside line n for a distance equaling its thickness. For the lower parts within line l, the fascia touches line n as does the inner diameter of the lower scotia t, and you can construct its fillets in a similar way to the upper one, as I have drawn here without describing it further. (Dürer 1525: fol. h iij verso)²⁶

Thus Coecke can in fact be credited with the first successful, almost perfectly parallel combination of text and graphics to explain the construction procedure of a column element. Similarly, Coecke's illustration of the Corinthian capital is much more complete, in the sense of independent from the accompanying text, than Dürer's (compare Coecke van Aelst 1539a: fol. c 5 recto [Fig. 2] with Dürer 1525: fol. h iij verso). As Carpo has remarked, this way of working is reminiscent of the oral transmission of knowledge proper to the workshop and the world of the guilds (Carpo 2003).²⁷ On the surface, the circle segments illustrating the general proportions of the Doric pedestal in Coecke's drawing (3:2) might refer to late mediaeval proportioning techniques with the compass, familiar to many in his audience. But they are not essential. The compass lines might even be said to be redundant since the same information is available through the scales. The *Inventie* cannot be reduced to a crafts manual only, even if the 'lovers of architecture' addressed in the title

also include practitioners of the building trades, and even if the large print run (of over 650 copies), the pocket size, and the low price of a single stiver (*stuiver*) all suggest that particular format (Schéle 1962). Both the opening (I–II) and closing chapters (VIII–X), which bookend the central section on the orders, are uncompromisingly Vitruvian in terminology and tone, defining 'architecture' as an intellectual activity based on scientific principles, and discoursing on antique temples and on proportion. Moreover, like the first translation of Sebastiano Serlio's *Quarto libro* (1539), the *Inventie* was printed in a Roman font, not at all easy to read by the common artisan.²⁸

The world of construction is to a large extent still a closed book to us where it comes to the actual use of geometrical rules of thumb and the tradition of proportioning systems. Contrary to the German lands where some of this knowledge was translated into print at the instigation of enlightened patrons already at the end of the fifteenth century, as we have seen, for the Low Countries only a few sources survive. One particular case may be compared to the German finial booklets, even if it lacks text. It is related to the practice of Alart Duhamel, a respected master who worked on the building sites of the main churches at 's-Hertogenbosch (1478–1494), Antwerp (1478–1494) and Leuven (1495–1502) (Verreyt and Lehrs 1894; Peeters 1985: 39–40). Duhamel's designs for a monstrance in the form of a sacrament tower and for a complicated canopy

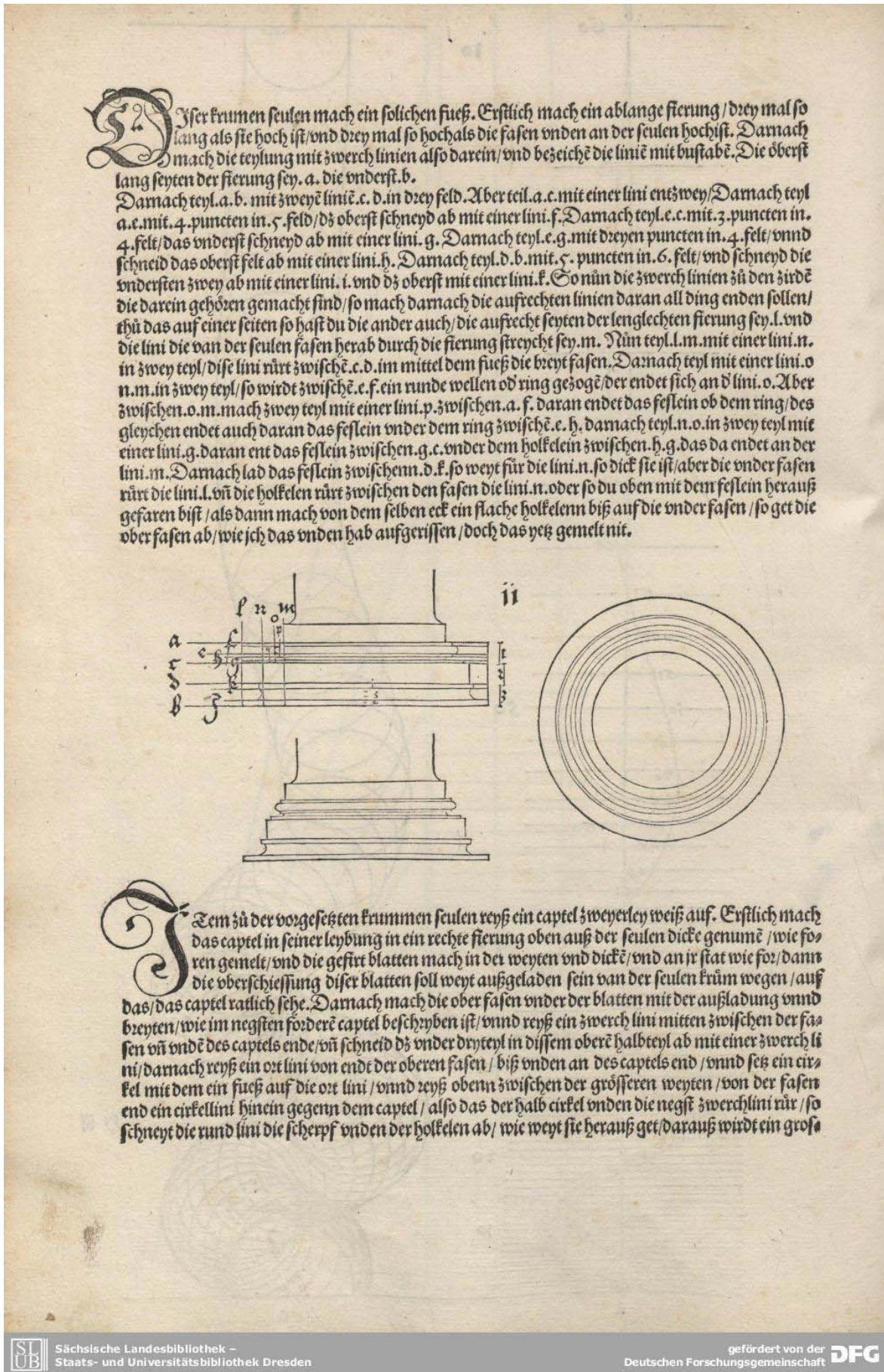


Fig. 6: Albrecht Dürer, *Underweysung der messung* (Nuremberg, 1525), fol. h iij verso. Staatliche Landes- und Universitätsbibliothek Dresden.

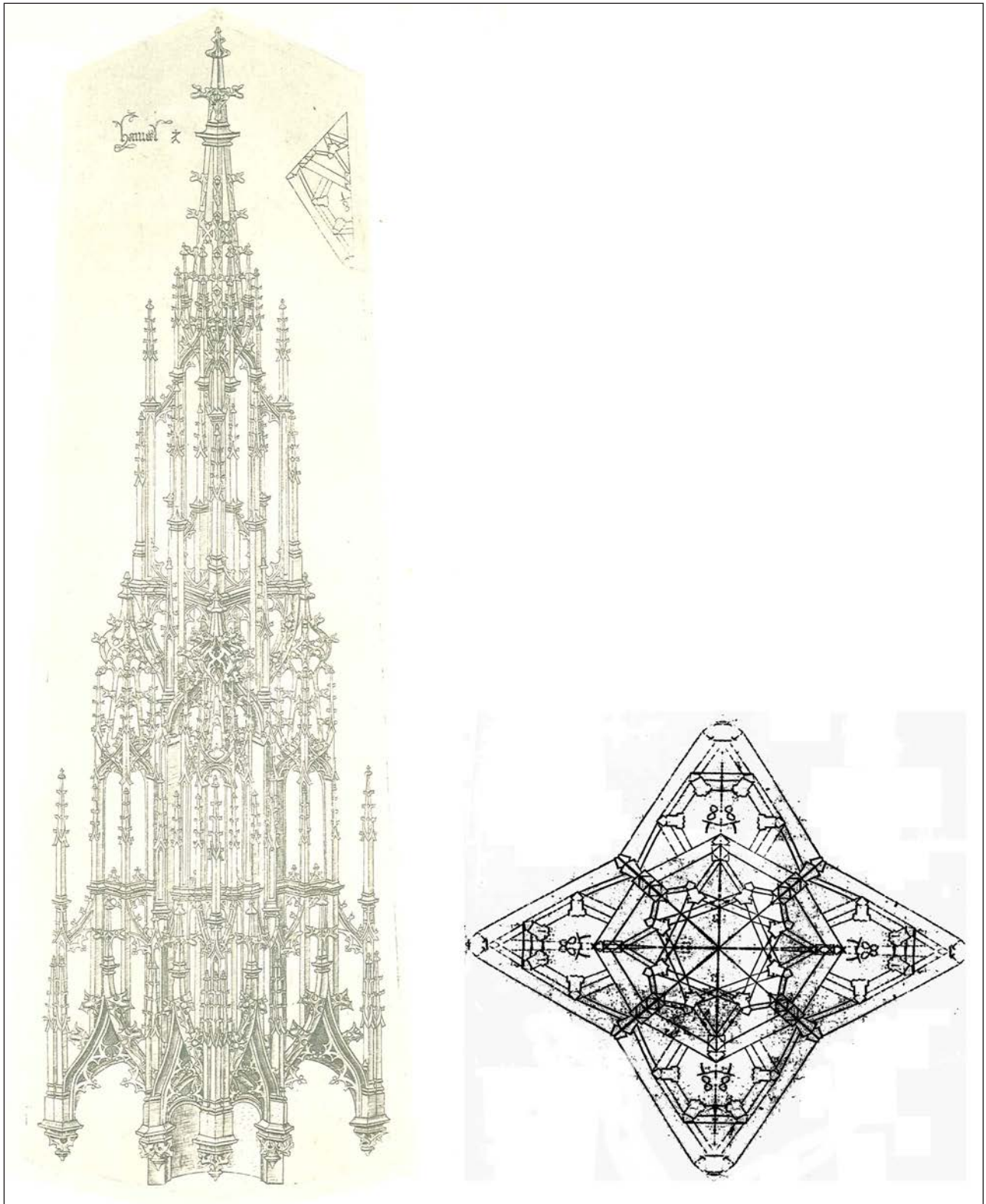


Fig. 7: a) Alart Duhamel, *Design for a baldachin*, engraving, c. 1490. After Lehrs 1930: pl. 205. **b)** Reconstruction of the design. Author.

were published in the form of large, signed prints, composed of several leaves.²⁹ These prints were obviously not destined for the lower end of the market; like the German manuals, they might have been of interest to the learned collector. They include, in a kind of geometrical shorthand which is perfectly clear to those who have mastered the art of the compasses, the essence of Duhamel's design.

The key is given by the notation '1/8', indicating that the diagram must be multiplied by eight (**Figs. 7a** and **7b**).

By flipping (achieving one quarter of the plan) and rotating it, the basic plan of his concept and even its proportional scheme may be known. The result is the kind of 'compressed' plan (in which several levels are projected upon a single plane at the base) familiar from

Gothic architectural drawing.³⁰ This form of geometrical notation may be found in other Netherlandish drawings, too.³¹ A painter such as Coecke, trained in the rendering of architecture, must have been as familiar with this projective geometry as was Dürer.³² His presentation of the Corinthian capital in a combined plan and vertical profile at least seems to suggest as much (**Fig. 2**).³³

A late sixteenth-century source offers an inkling of what the accompanying oral explanation, transmitted in the workshop, could have been like. The imposing, 578-folio manuscript *Architectura. Dat is constelicke bouwijnghen huijt die Antijcken ende Modernen (Artful Buildings from the Antique and the Modern)* of 1596–1600 was compiled by the Bruges master mason Charles De Beste at the end of his life (Van den Heuvel 1994; Van den Heuvel 1995). In his *Second Book on Geometry* he not only drew upon current manuals such as those of Serlio and Dürer but also on older lore (De Beste 1595–1600: Book II, Chap. XVI, fol. 80 recto–fol. 92 recto; new foliation). In ninety-nine examples he demonstrates the 'art of using the compasses' by drawing complicated tracery patterns for semi-circular arches (*boghen ofte verwelffsels*), followed by fifteen rectangular fields which may be used for parapets (*bostweeren*) or below the windows in the façade (*onder die veijnsteren in viercante percken*) (**Fig. 8**).

He finds the need, however, to write a detailed explanation for the procedure in each example, using a technical vocabulary familiar to us from early sixteenth-century contracts and accounts (see Philipp 1989 for samples; for a more extended discussion, see De Jonge 2011a). The similarity with Coecke's procedure for the construction of the pedestal is striking; here also the design is generated from the base line upwards with the compass. For instance:

In figure 17 the base line is divided into twelve and two lines are drawn from the fourth and the eighth part upwards towards the apex [of the half-circle, forming a triangle]. Next the vertical sides of [each] square [defined by the radius of the half-circle] are divided into six parts, and both third parts are connected with a [horizontal] line. Also the fifth parts are connected with a transversal line. Where both these lines are intersected by the triangle, we find the centers for the eyes or circles, and so on as shown in the figure. (De Beste 1596–1600: fol. 68 recto, explanation of tracery design nr. 17 (or 323)³⁴

Coecke's image of the pedestal may have profited not from similar Gothic designs³⁵ but from the schemes added by the anonymous French translator of the *Medidas del romano* (De Sagredo 1526), which show the complete column order (**Fig. 9**).³⁶ This Vitruvian dialogue was published in Spanish in 1526 by Diego de Sagredo in Toledo, and appeared as *Raison d'architecture antique* some time in the early 1530s at Simon de Colines' shop in Paris (*Raison d'architecture antique*; Lemerle 2000).³⁷ The original illustrations, being rough woodcuts, could not be used in any way for the correct proportioning of the pedestal, or of the column base. The anonymous translator brought the

profile of each base nearer to the circle showing the lower horizontal section of the column, and added a regularly subdivided diameter, thus greatly increasing the functionality of each illustration (*Raison d'architecture antique*: fol. 25 recto–fol. 27 verso; cf. De Sagredo 1526: fol. C iij verso–fol. C vi verso). Still, here also the pedestal was shown in a painterly perspective view without construction lines (*Raison d'architecture antique*: fol. 28 recto; cf. De Sagredo 1526: fol. C vij recto). For the proper dimensioning of each part one still had to read the accompanying text very carefully. The illustrations of the orders added by the translator, on the other hand, can be understood independently from their accompanying text (*Raison d'architecture antique*: fol. 44 recto–fol. 45 verso) (**Fig. 9**). Each order now has a pedestal with specific proportions, indicated by circles in another demonstration of the art of the compasses. This is indeed the first systematic inclusion of the pedestal in the system of the orders, predating Serlio's Book IV. Serlio on the contrary chose Latin formulae in the tradition of Boethius to express the proportional relationship (*proportione quadrata, diagonea, sesquialtera, superbi-partiens tertius, and dupla*). The author of the Sagredo translation is unknown, but the numerous errors and confusions in the text of the *Raison* are clear evidence of his unfamiliarity with the Spanish language on the one hand and with this new architectural vocabulary on the other.

Geometrical and arithmetical notations combined

Coecke does not stand alone in the Northern artistic milieu of the 1530s. There may indeed be counterparts to his combined geometrical and arithmetical presentation of the proportions of the column. A significant step along similar lines may be found in the work of a Netherlandish anonymous artist active in the 1530s, whose repertory of forms is extremely close to that of the very influential sculptor Jean Mone, 'artiste de l'empereur' to Charles V from 1521/1522 (De Jonge 2010a; on Mone, see also De Jonge 2010b, with older literature). In a model book on vellum (*Model Book of the Five Orders*), now conserved in Madrid in mutilated form,³⁸ this artist gives a demonstration of the proportioning of each of the five orders (with the Plinian proportions used in Serlio's Book IV for the height of the columns) with the compasses (De Jonge 2011b).

The examples that follow each proportional scheme showcase the column shaft and its decoration in many inventive (and fundamentally un-Roman) ways, reminiscent of the work of Mone and his many Netherlandish followers but also of the Spanish context of his earlier career (he worked with the sculptor Bartholomé Ordóñez in Barcelona from 1517). Unfortunately, only the schemes showing the Grecian orders have survived (**Fig. 10**).

The *Model Book* includes not only the pedestal but also the entablature of the order in demonstrations with circles for a column, baluster and pilaster. Smaller circles, the diameters of which correspond to the radius of the column in the thickest part of its shaft (at the entasis), are superimposed on the column base and capital in the Doric and Ionic schemes, showing that they are of the

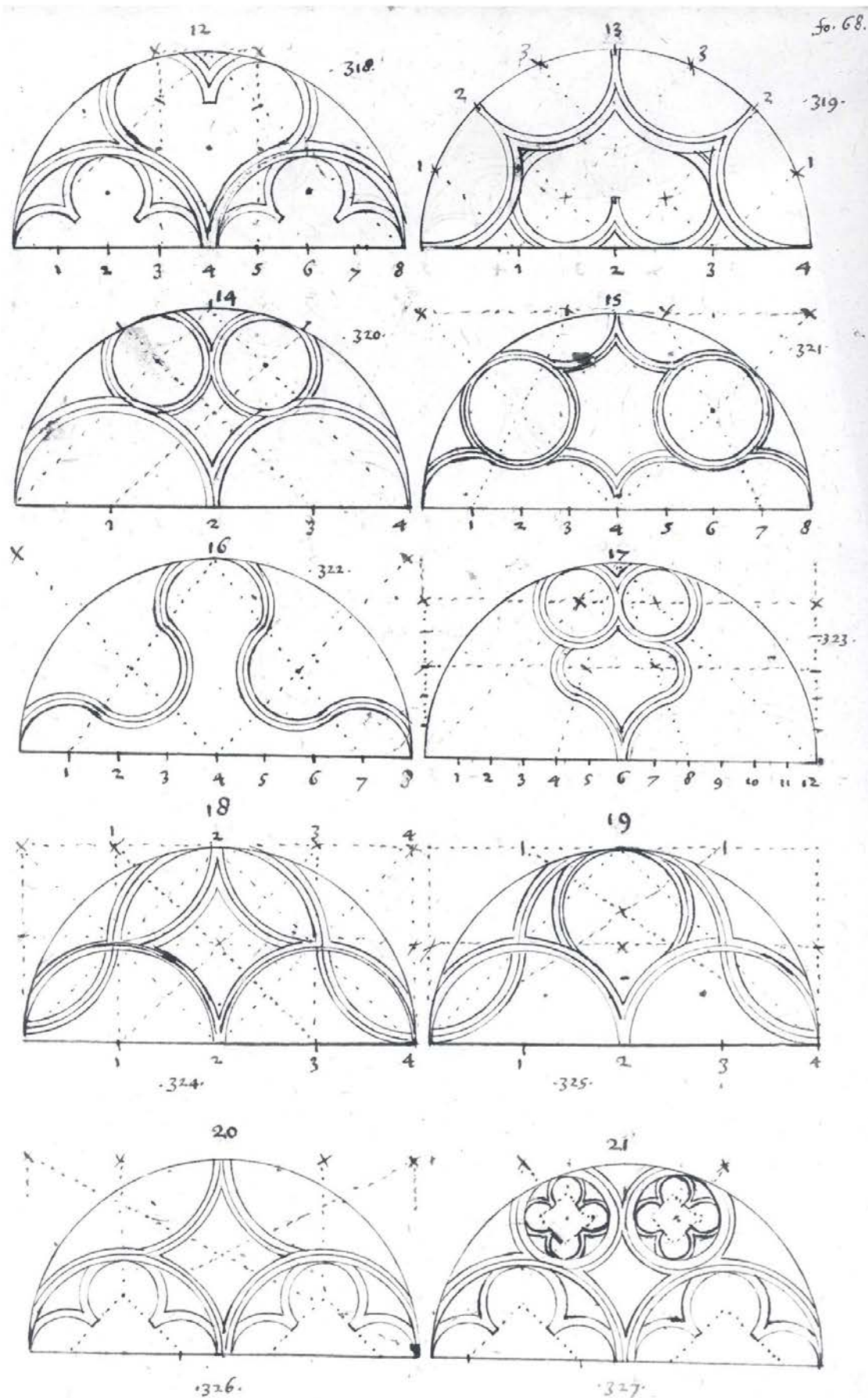


Fig. 8: Charles De Beste, *Architectura. Dat is constelicke bouwijnghen huijt die Antijcken ende Modernen* (Bruges, 1596–1600), fol. 68 recto: Tracery designs. Brussels, Royal Library of Belgium.



Fig. 9: French Anonymus, *Raison d'architecture antique* (Paris, before 1536), fol. 45 recto: Proportioning of the Tuscan (i.e. Composite) order. University of Virginia Library.

same height. Larger circles are used to show the proportions of the die of the pedestal, which, as in Coecke's *Inventie*, is as wide as the plinth of the column base.

Their relationship to the smaller circle is not immediately obvious in the Doric and Ionic schemes, but in the Corinthian one, the die and plinth are subdivided into

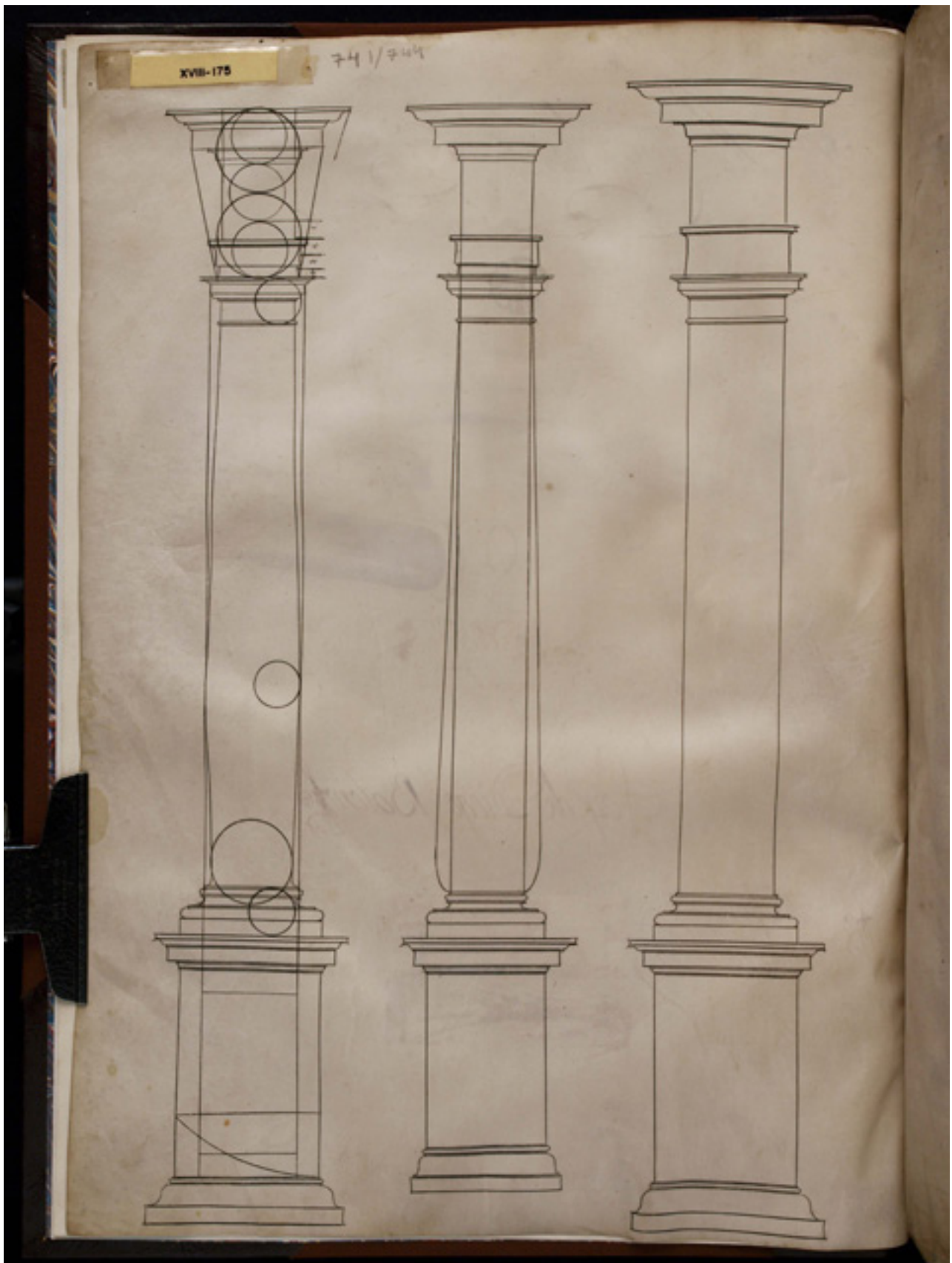


Fig. 10: *Model Book of the Five Orders*, fol. 9 verso: Proportioning of the Doric order. Madrid, Colegio de Arquitectos.

sixths by smaller half-circles, the column diameter at the entasis (highlighted by four small circles) corresponding to four sixths of the former. For every order, the height of the entablature is indicated by three vertically stacked

circles of intermediate size; according to a numbered scale in the Doric and Ionic schemes, the architrave takes up three fourths of the diameter, while the cornice equals one circle and the frieze one circle and a fourth part. For

the Ionic and Corinthian Orders, the intermediate circle corresponds with the upper diameter of the column shaft; its relation to the larger column diameter is not shown in the Ionic case. According to the Corinthian scheme, however, it equals three fourths (indicated by three small half-circles) of the larger diameter. In the case of the more hefty Doric column, the three intermediate or entablature circles equal two times the upper column diameter, also drawn in. Thus, since the pilasters of the three orders do not have an entasis or taper in any way, the entablature of the pilaster order is systematically taller than that of the variants with columns.

This manuscript, or another copy, was known in the Antwerp milieu, as may be deduced from its *Nachleben* in the work of Hans Vredeman de Vries, amongst others in the latter's first essays on the orders and their ornament of 1565 and in his 1577 treatise *Architectura oder Bauung der Antiquen auss dem Vitruvius*.³⁹ The anonymous author of *Model Book* indeed had many of his designs published, which were used widely and for a long time: Charles De Beste, for instance, inserted several of them into his *Fifth Book on Architecture* to illustrate tombs, church furniture, façades of palaces, etc. (De Beste 1596–1600: fol. 363 recto (tomb), fol. 364 recto (stalls), fol. 364 verso (tabernacle), fol. 365 verso (small tabernacle), fol. 366 recto (altar dated 1534), fol. 366 verso (reliquary), fol. 374 recto (five-bay façade). Prints (or proofs) which seem to have been based on the Madrid model book, were recently discovered by Peter Fuhring (*Print Proofs*).⁴⁰ However, these combine the demonstration with circles with a notched scale on the side, and thus come one step closer to the *Inventie*.⁴¹ As in Coecke's representation of the pedestal, two different methods are combined here. These prints, or their preparatory drawings, were certainly known to De Beste, who carefully copied all of them (**Fig. 11**).⁴²

They may also be compared to the representation of the orders in a French manuscript treatise on geometry which belonged to Henry VIII of England (*Geometria*; Thurley 1993: 89 and 94, fig. 123).⁴³ Schemes for pedestals drawn with circles taken from the *Raison d'architecture antique* are combined here with a half section along the axis, subdivided into numbered parts; the Ionic entablature shows the three circles characteristic of the Anonymus *Model Book of the Five Orders*, while the Tuscan column has obviously been borrowed from Serlio's Book IV. Jacques Androuet du Cerceau the Elder, who liberally borrowed from the *Model Book* throughout his career (especially column shaft ornaments and designs for goldsmith's work), uses horizontal, numbered subdivisions and circles in the album on vellum which he created for Governor Peter Ernst von Mansfeld in the mid-1550s (Androuet du Cerceau c. 1555: especially fol. 132 recto–fol. 140 recto; for dating of the binding, see Le Bars 2007: 166–167).

Without doubt, Hans Blum's singular way of representing the orders, both in his *Quinque columnarum exacta descriptio atque delineatio cum symetrica earum distributione* (Zürich, 1550) and in the *Ein kunstreych Buoch von allerley antiquiteten* (Zürich, c.1560), is also based upon these precedents. The 1550 Latin book on the orders had been published in German in the same year (as *Von den*

fünff Säulen Grundtlicher bericht) and published in French by Hans Lieferinck in Antwerp in 1551 (with the title *Les cinq coulomnes de l'architecture, ascavoir, la Tuscane, Doricque, Ionicque, Corinthie, & Composite, avec la vraye symmetrie & proportion dicelles*), followed by many other editions (Schildt-Specker 1988; Hänslı 2004; Hänslı 2006). The double-size (or 'imperial size', as Lieferinck calls it), fold-out leaves show a combination of numbered scales (both horizontal and vertical) and diagrams with circles (for pedestal and entablature), combined with Serlio's particular way of indicating the diminution of the column above the *entasis*. The *Kunstreych Buoch* has similar foldouts and comes even closer to the *Model Book's* proportional schemes, as circles are also used here across the thickness of the column shaft (**Fig. 12**). Blum's considerable influence in France, Germany, the Netherlands and England until the seventeenth century, including in such well-known treatises as Jean Bullant's, is thus also indebted to these earlier experiments in representing the proportional relationships of the column order (Pauwels e.a. 2004; Pauwels 2008; Pauwels 2010).

Conclusion

In the Low Countries of the early modern period (De Jonge 2012) the Vitruvian column orders offered a new field for experimentation to artists trained in the Gothic culture of proportion. The result of such experimentation cannot be qualified simply as 'traditional', as Carpo did in his 2003 essay; nor can an overt 'battle' between geometry – standing *pars pro toto* for the Gothic – and numeracy – seen as characteristic for Renaissance architectural theory and practice – be observed in the surviving sources.⁴⁴ In the stylistically pluralistic Netherlandish context, textual description of geometrical procedure could be combined with graphical demonstration of the art of the compasses and with numerical notation, as shown both by Dürer's *Underweysung* and Coecke's *Inventie*. In spite of its erudite Vitruvian literary format, the *Inventie* presented a notation system understandable by all, from the erudite amateur of geometry and architecture to the members of the construction guilds. This is entirely in keeping with Coecke's intention to establish a new, universally understood terminology of architecture. In his Serlio editions he consciously did not translate the Italian *volgare* terms, preferring to use the Latin ones given by Vitruvius, as he explains in the preface to the second Flemish edition of Book IV:

Taking into account that not all lovers of architecture understand Italian, I have translated these to my opinion definitive and very clear rules from Italian into Flemish (*nederlants*), with the exception of all parts of the bases, capitals, cornices, etc. These I did not put into Flemish (*verduyts*) even if Serlio mentions the usual modern terms of Italy – which we would understand as badly as the Latin ones – next to the Vitruvian ones. I would recommend that we use the terminology of Vitruvius (*der namen Vitruvij*) since we received his way of building in writing, in order that the scholar can be

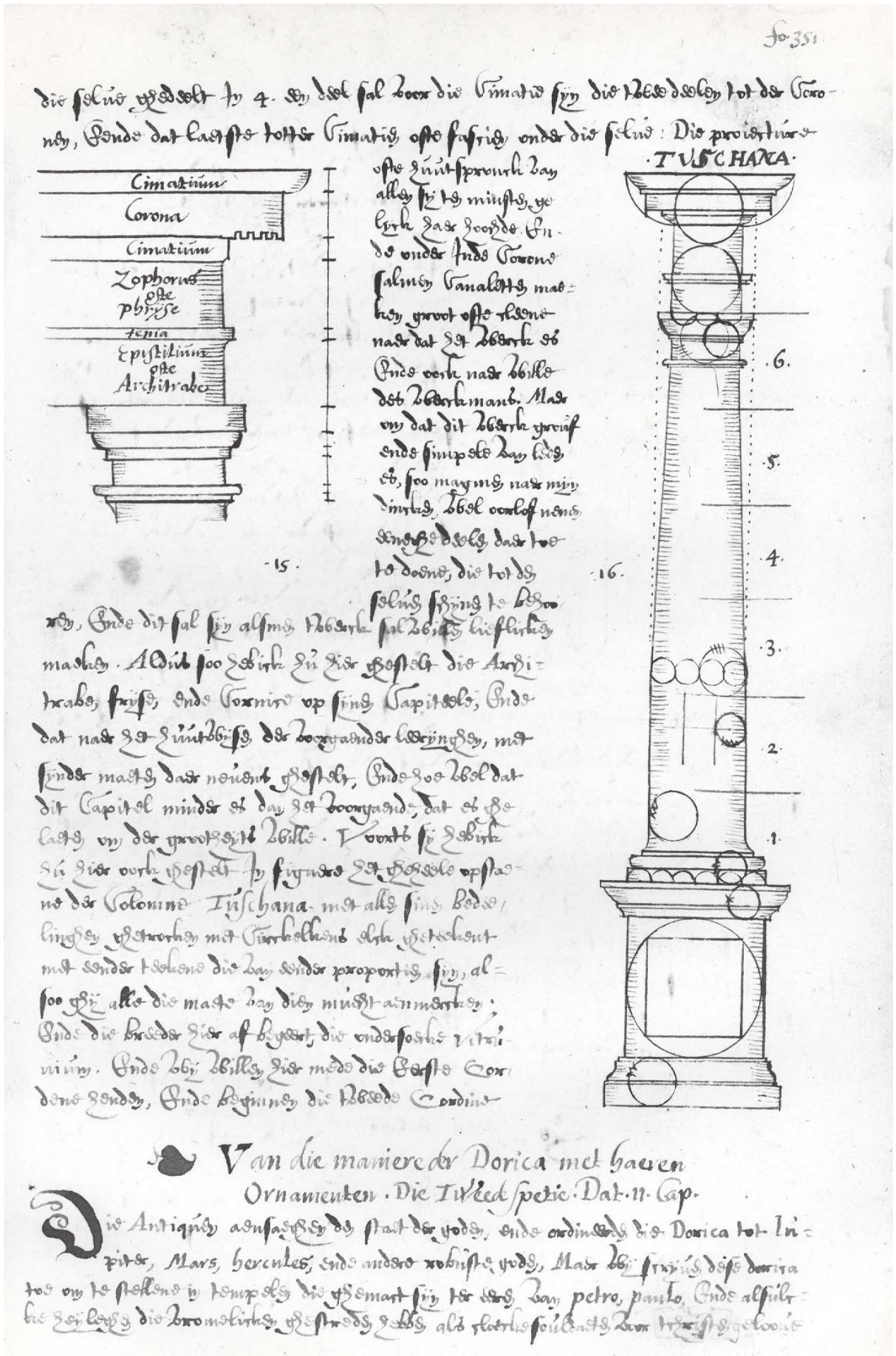


Fig. 11: Charles De Beste, *Architectura: Dat is constelicke bouwijnghen huijt die Antijcken ende Modernen* (Bruges, 1596–1600), fol. 351 recto: Proportioning of the Tuscan order. Brussels, Royal Library of Belgium.

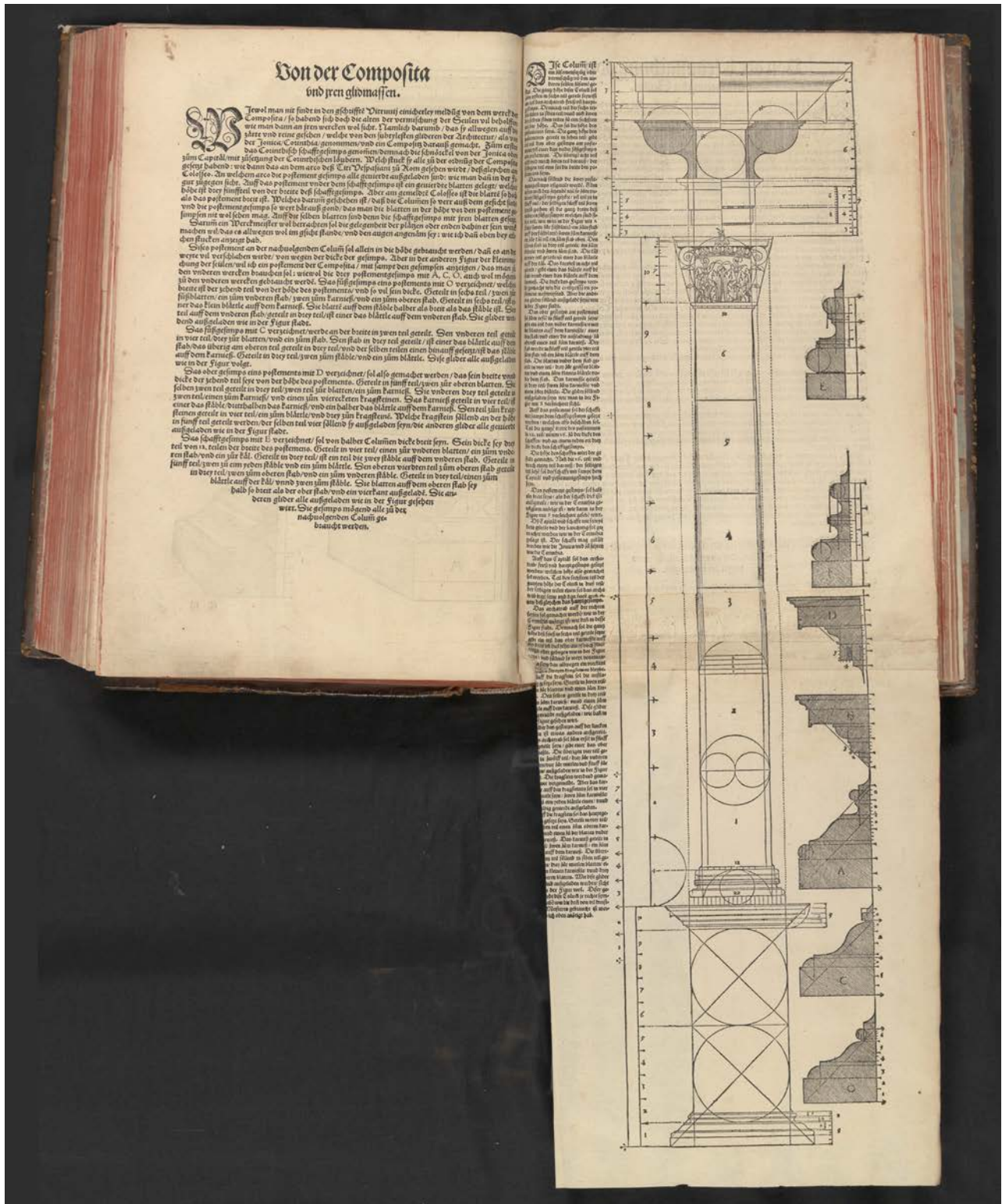


Fig. 12: Hans Blum, *Ein kunstreych Buoch von allerley antiquiteten* (Zürich, c. 1560), fol. B ij recto: Proportioning of the Ionic order. Ghent, University Library.

understood by the craftsman and the craftsman by the scholar. (Coecke van Aelst 1549: Preface)⁴⁵

The drawings in *Die Inventie* could also be understood both by the craftsman and the scholar, even one only moderately familiar with compasses and with Euclidian basics⁴⁶: There was no secret knowledge involved in it, contrary to, for instance, Alart Duhamel's prints. The

booklet's low price of only one *stiver* – one-fourteenth the cost of the Serlio translations, which were priced at one guilder – made it affordable. Conversely, expensive manuscripts on vellum, such as the Madrid model book, and folio-sized printed books with copperplate fold-out illustrations, such as the Lieferinck edition of Blum's treatise, must have addressed chiefly the upper end of the market – the well-heeled collectors and learned dilettantes 'who

take pleasure in the buildings of antiquity' and socially aspiring artists.⁴⁷ Paradoxically, their notation system was more hermetical, necessitating experience with tools of the trade such as the compass, to be fully understood.

Notes

- ¹ On Coecke's publications, see De Jonge (1998; 2004; 2007b). On Coppens van Diest, see Valkema Blouw (1988).
- ² The first to bear this title was the sculptor Jean Mone, who might have introduced the title into the Low Countries following the example of Bartholomé Ordóñez in Barcelona, with whom he worked between 1517 and 1520; the third is the sculptor-architect Jacques Du Broeucq, who worked for Regent Mary of Hungary in the 1540s and 1550s.
- ³ Antwerp masters testified on architectural design, for instance, in Utrecht in 1543 (Muller Fz. 1881–1882).
- ⁴ See Han Vandevyvere's analysis of the town hall at Leuven (1439–1469), based on the building accounts, <http://www2.asro.kuleuven.ac.be/asro/Nederlands/stadhuis/analyse/Stadhuiss.htm> – Getallensymboliek en proportiesystemen. A possible promising case study would be the lost hunting pavilion of Mariemont, built by Jacques Du Broeucq for Mary of Hungary (1546–1549), since the accounts also offer a full set of dimensions (De Jonge 2005).
- ⁵ For a similar hypothesis concerning the ad quadratum design of towers in the Southern German context, sixteenth to eighteenth centuries, see Müller (1978).
- ⁶ Rykwert distinguishes two types of discourse in the period between 1000 and 1500: the literary, public, Vitruvian one, used by literati and patrons, and the practical, 'secret' one based on Euclid, proper to stonemasons and other practitioners of the building crafts. Philibert Delorme, known both for his mastery of the column orders and of the tradition of French stereotomy, explicitly wanted to combine Vitruvian and Euclidian discourse into the perfect demonstration of the science of architecture in his 1567 treatise, see Sanabria (1989: 271–281).
- ⁷ Copies of Gaurico 1528 are conserved in Berlin, Leiden, London, Utrecht, Brussels (Nijhoff and Kronenberg 1923: 348, cat. nr. 961), Ghent (Universiteitsbibliotheek, NK961) and Leuven (BRES 7A808). For the other publications of Joannes Grapheus, see Rouzet (1975: 38, cat. nrs. 57–59 and 68) and Cockx-Indestege and Glorieux (1968: 583–584).
- ⁸ The full title (see References) confirms that the book is also addressed to architects.
- ⁹ This runs contrary to Carpo (2003: 451), who erroneously sees a widespread aversion to general fractions (a/n , $a > 1$) in Northern Europe in favour of unit fractions ($1/n$) in classical mathematics as understood by Italian humanists. In the Dresden manuscript of *On Human Proportion*, for instance, the proportions of a child's limbs are expressed in fractions such as $4/15$ and $2/23$.
- ¹⁰ $31/22$, $17/12$, $7/5$... for $\sqrt{2}$, for instance.
- ¹¹ Sanabria (1982: 286) thinks that Rodrigo's rules are the first to extract the square root arithmetically rather than geometrically, but Kidson's analysis of Mathes Roriczer's so-called *Geometria Deutsch*, four pages of geometrical problems added to his better-known booklet on finials (1486), suggests some familiarity with arithmetical geometry on the latter part. Kidson (2008) thus contradicts much of the accepted view (see amongst others held by Shelby (1972) and by Birkett and Jurgenson (2001)) that the geometrical knowledge of medieval masons was limited to the practical and did not include more theoretical issues.
- ¹² Only three copies out of a print run of more than 650 survive: Ghent, University Library, BHSL.RES.1448, incomplete (facsimile in Rolf 1978); Wolfenbüttel, Herzog August Bibliothek, 40.5.1 Geom., with water stain (Davis 1994: 29–30); and Munich, Bayerische Staatsbibliothek, A. civ. 53.
- ¹³ 'Ende want dan dese maniere der Grieken die wij Antijcs noemen (midts imperfectien der onser) nu by ons die overhant neemt, by avontueren duer nieuwicheit, oft datse ons beter behaecht, oft naer mijn duncken om haerder volmaecter sekerheit ende redenen der Simmetrien, die so menich hondert jaer onverandert gebleven is, vander welcker nu den meesten hoop den schijn volcht, tot verachting huers werx ende der antiquen daeraf sij den naam gebruecken. Ende om dattet den eenen duer dees oorsake, den anderen duer die, niet gelegen en is anders dan sijn moederlike tale te leeren, oft veel boecken te hebbben, so hebbic tgene dat ic wt Vitruvio ende ander vergadert hebben, so veel als ict verstaen can vande Simmetrien der timmeringen, ooc de inventie der Columnen, ende proportie der selver, met den Coronementen, niet van cap. tot cap. maer alleen de nootsakelixte punten voer my wtgesocht, want ic tot grooten saken niet geschict en bin'. See also fol. a 5 verso: 'ooc de sware questien der Simmetrien met redene der Geometrien worden gevonden'. Today the term is usually taken to mean 'reflection symmetry'. Simon Stevin was the first to define it as such in his (unpublished) *Huysbou* ('lycksydicheyt') (Van den Heuvel 2005: 167, 176–178).
- ¹⁴ '...midts dat ick sie dat hem den meestendeel van onsen werck lieden, alleene metter handelingen laten genoegen, ende lutter daer op achten, oft huer wercken met rechter simmetrien gemaect zijn, dat welcke nochtans seer confuys es voer die verstandige te siene, in sulcken sonderlingen wercken, dewelcke aengaende der handelingen, bijna den Italiaenschen souden mogen voorgesedt worden'.
- ¹⁵ See the dedication to Willibald Pirckheimer in Dürer (1525: fol. a i verso).
- ¹⁶ Hubach (2008: 118–120) counts Vitruvius among the sources of Lechler's treatise. On this context, see also Versteegen (2003).
- ¹⁷ For discussion of its geometry, see Shelby (1972) and Kidson (2008) (amongst others). For discussion of its relation to the mason's lodge and its secrets, see Rykwert (1982).

- ¹⁸ Except for the addition of the Tuscan order to the Vitruvian triad of Doric, Ionic and Corinthian (Chapters III–VII).
- ¹⁹ Coecke does use notched rectangles in his schematic plan of the Tuscan temple, see Coecke van Aelst 1539a: fol. d 3 recto.
- ²⁰ See the attic base in Cesariano (1521: Book III, fol. 47 recto). The letters are meaningless unless one decipheres the text.
- ²¹ 'Haer Simmetria maectmen aldus. Beghinnende aent Plinthus opden gront seit Vitruvius, salt breeet sijn .ij. columnen dicten, ende hooge seit Cesarianus .iij. columnen dicten. Die onderste breede opden gront deeltmen in .vij. wt de .vi. binnenste deelen trectmen tsilobatum oppe, de .ij. deelen worden der proiecturen gelaten, een van dien deelen is Tplinthus hooge, ende noch een deel heeft die basis verstervende tegen tpluteum oft stilobatum. Maer salt Dorica sijn, so is de bovenste cimatie oock also breeet ende dicke met die Corona lisis inghesneden met triglyphi ende metophe, oock met tenia ende gutten. Dit volbracht sijnde, setmen de Spira, ter breedden van dat Stilobatum, ende die wort nader Simmetrien perfectelijc aldus gemaect. Dat die dicke met dat Plinthus sy van de helft der columnen dicten, ende die proiecturen die de Grieken Ecphoron noemen hebben dat .vi. deel, die .iij. deelen bliven der columnen also datse lanck en de breeet sy een dicke ende een halve der columnen.'
- ²² Coecke might have used famous libraries such as those by Peter Gillis (Aegidius), Grapheus' predecessor, or Canon Willem Heda's, whose house in Antwerp (built before 1525) featured pilasters with arabesque ornaments taken from contemporary northern Italian prints in his collection (Tournoy and Oosterbosch 2002; Van Langendonck 2002).
- ²³ With thanks to Howard Burns for pointing to Alberti. Simile taken from Carpo (2003: 449–450).
- ²⁴ 'De hoochde salsy seithy Atticurga sijn (want vande Spira dorica en sedt hy anders gheen bescheet) wordde gedeelt al dus, dat bovenste op dat derdendeel der columnen dicten, de reste wort den plinth gelaten. Sonder tplintus, worddet boven gedeelt in iij. ende van een deel wort dat thoros boven gemaect, die ander .ij. deelen wordden in .ij. gedeelt, van dat .i. deel maectmen dat nederste thoros, ende dat ander wordden die quadren ende Scotia, welcke de Grieken Trochilon heeten'.
- ²⁵ According to the accompanying illustration, it is actually four times as large as it is high (but if one includes the reglet, the proportion of 3:1 is correct).
- ²⁶ 'Erstlich mach ein ablange fierung / drey mal so lang als sie hoch ist / vnd drey mal so hoch als die fasen vnden an der seulen hoch ist. Darnach mach die teylung mit zwerch linien also darein / vnd bezeichnen die linien mit bustaben. Die oberst lang seyten der fierung sey .a. die vnderst .b. Darnach teyl .a.b. mit zweyen linien .c.d. in drey feld. Aber teil .a.c. mit einer lini entzwey / Darnach teyl .a.e. mit .4. puncten in .5. feld / das oberst schneyd ab mit einer lini .f. Darnach teyl .e.c. mit .3. puncten in .4. felt / das vnderst schneyd ab mit einer lini .g. Darnach teyl .e.g. mit dreyen puncten in .4. felt / vnd schneid das oberst felt ab mit einer lini .h. Darnach teyl .d.b. mit .5. puncten in .6. felt / vnd schneyd die vndersten zwey ab mit einer lini .i. vnd das oberst mit einer lini .k. So nuⁿ die zwerch linien zu^o den zirnen die darein geho^oren gemacht sind / so mach darnach die aufrechten linien daran all ding enden sollen / thu^o das auf einer seiten so hast du die ander auch / die aufrecht seyten der lenglechten fierung sey .l. vnd die lini die van der seulen fasen herab durch die fierung streycht sey .m. Nuⁿ teyl .l.m. mit einer lini .n. in zwey teyl / dise lini ru^rt zwischen .c.d. im mittel dem fueß die breeet fasen. Darnach teyl mit einer lini .o. .n.m. in zwey teyl / so wirdt zwischen .e.f. ein runde wellen oder ring gezogen / der endet sich an der lini .o. Aber zwischen .o.m. mach zwey teyl mit einer lini .p. zwischen .a.f. daran endet das feslein ob dem ring / des gleychen endet auch daran das feslein vnder dem ring zwischen .e.h. darnach teyl .n.o. in zwey teyl mit einer lini .g. daran ent das feslein zwischen .g.c. vnder dem holkelein zwischen .h.g. das da endet an der lini .m. Darnach lad das feslein zwischenn .d.k. so weyt fu^r die lini .n. so dick sie ist / aber die vnder fasen ru^rt die lini .l. vnd die holkelten ru^rt zwischen den fasen die lini .n. oder so du oben mit dem feslein herauß gefaren bist / als dann mach von dem selben eck ein flache holkelenn biß auf die vnder fasen / so get die oberfasen ab / wie jch das vnden hab aufgerissen / doch das yetz gemelt nit.' Transcription is online at http://de.wikisource.org/wiki/Underweysung_der_Messung_mit_dem_Zirckel_und_Richtscheyt_in_Linien_Ebenen_unnd_gantzen_corporen/Drittes_Buch, ad no. 94.
- ²⁷ On the subject of oral tradition, see Shelby (1972); Rykwert (1982); Carpo (2001: 23–41).
- ²⁸ Tellingly, for the second Flemish edition of the *Quarto Libro* (1549), Coecke and his printer went back to the more common Gothic font: Coecke van Aelst 1549 (De Jonge 2004: 272–274).
- ²⁹ The sacrament tower print is composed of three leaves, the upper one measuring 345 by 151 (upper width) / 153 (lower width) mm, the central one 344 by 199/204, and the lower one 424 by 204/256. Examples are conserved in Paris (Musée du Louvre, Collection Rothschild) and Vienna (Graphische Sammlung Albertina) (Lehrs 1930: cat. no. 494, pl. 205; Jean-Richard 1987: 48–49, cat. no. 60. Hutchison 1991: 247, nr. 0911.009). Copies of the baldaquin may be found in Dresden, London (Victoria and Albert Museum) and Vienna (Lehrs 1930: cat. nr. 495, pl. 206; Hutchison 1991: 231–251, particularly nr. 0911.010).
- ³⁰ See, for instance, the designs for Vienna cathedral in Böker 2005. Analysis in Velte (1951: 29–37); Booz (1956: 37–66); Bucher (1968). Critical notes in Hecht (1969) Hecht (1970); Hecht (1971–1972); Hecht (1979); and Bork (2003). See also the contribution of Robert Bork to this volume.
- ³¹ See, for example, *Bishop's Cross*, reminiscent stylistically of Pieter Coecke and Cornelis Bos. London, Victoria and Albert Museum, inv. E 739–1912. Published by Byrne (1977: 161 note 18 and pl. 17) as a Flemish drawing.

- ³² He was possibly trained by Jan van Dornicke in Antwerp, one of the representatives of so-called Antwerp Mannerism, characterized by complicated architectural backgrounds (Marlier 1966: 109–147; Martens 2004/2005; Born 2005; Martens and Peeters 2006).
- ³³ Here also he is indebted to Dürer (1525: fol. h iij verso) for the rotated plan of the capital.
- ³⁴ 'Die 17. figure is die basis linie ghedeelt in 12 ende 2 linien ghetrocken huut het 4. ende het 8. deel loopende boven naer die middele. Voorts beede die perpendicularen linien des viercants ghedeelt in 6 deelen, ende naer beede 3 deelen een linie ghetrocken. Ende oock van beede die 5 deelen oock een diametrale linie ghetrocken. Ende daer dese 2 linien duersneden worden vande triangels linien, daer sijn die centrums om die ooghen ofte circlen te treckene, ende voorts alsoe hu die figure bewijst.'
- ³⁵ On another level of complexity, see the procedure with base line and successive squares generated by the compass which underlies the Strasbourg façade drawing B analyzed in Bork (2005), and Bork's contribution to this volume.
- ³⁶ Coecke explicitly mentions Sagredo together with Cesariano on fol. c i recto. The Doric capital with egg-and-dart molding on fol. b viij recto derives directly from Sagredo. On Sagredo, see Marías and Bustamante (1986: 3–139); Llewellyn (1977); Llewellyn (1988); and Llewellyn (1998).
- ³⁷ We consulted the copy at the library of the Colegio Oficial de Arquitectos de Madrid, Fondo Antiguo inv. 104.
- ³⁸ 39 folios (37 on vellum, 392 x 279 mm, and 2 on paper, 382 x 279 mm), with non-continuous numbering from 9 to 49 (recto) and a modern binding.
- ³⁹ Vredeman de Vries shows a similar predilection for the ringed column shaft in Vredeman de Vries 1565a and Vredeman de Vries 1565b (Fuhring 1997: XLVII, cat. nrs. 184, 190, 196, 207, 212, 217, 218). See also the Composite order in Vredeman de Vries (1577) (Fuhring 1997: XLVIII, cat. nr. 431).
- ⁴⁰ Berlin, Kunstbibliothek. See our joint (forthcoming) book on this artist, where they will be discussed by Peter Fuhring. With thanks to Peter Fuhring.
- ⁴¹ The Tuscan and Doric orders (first sheet) show a scale with numbering, but the Ionic, Corinthian and Composite orders (second sheet) do not. This discrepancy might serve to confirm that these are indeed unfinished proofs.
- ⁴² These drawings are reversed with regard to the prints (De Beste 1596–1600, fol. 351 recto (Tuscan order), 352 recto (Doric), fol. 354 recto (Ionic), fol. 354 verso (Corinthian), fol. 355 recto (Composite)). These pages also show images taken from Coecke (1539a), such as the Ionic entablature on fol. 353 verso, taken from fol. c 3 verso of *Die Inventie*.
- ⁴³ With thanks to Jean Guillaume for pointing me towards this treatise.
- ⁴⁴ 'The precocious rise of number-based computations in some sixteenth-century Italian architectural treatises on the orders broke with the adherence to traditional

geometry that predominated in most other European countries. The battle between geometry and numeracy continued unabated throughout most of the seventeenth century [...]' (Carpo 2003: 448).

- ⁴⁵ 'Ghemerct dan dat alle lief hebbers der Architecturen geen Italiaens en verstaen, so hebbick dese (na mijn oerdeel) aldersekerste ende claerste Reglen wt den Italiaensce in nederlandts overgesedt, behalven de namen van allen porceelen, der basen, capiteelen, cornicen etc. die en hebbick niet verduytst, hoe wel dat Bastiaen byde vocablen Vitruvij de geuseerde moderne vocablen van Italien sedt, der welcker wij sommige so qualijck verstaen souden als de Latijnsche; waeromme dat ick prijsen soude, angesien dat wij dees maniere van Vitruvio in scrifte ontfangen hebben, datmen hem der namen Vitruvij gewende, op dat de gheleerde vanden werckman ende de werckman vanden geleerden verstaen worden.'
- ⁴⁶ Available to artists, for instance, in Dürer's 1525 *Underweysung*, in which problems such as bisecting an angle, determining the centre of a circle segment, constructing a spiral, etc., are concisely explained.
- ⁴⁷ A quote from the title of Coecke van Aelst (1539a): 'allen die ghenuechte hebben in edificien der Antiquen'.

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How to cite this article: De Jonge, K 2014 Early Modern Netherlandish Artists on Proportion in Architecture, or 'de questien der Simmetrien met redene der Geometrien'. *Architectural Histories*, 2(1): 11, pp. 1–23, DOI: <http://dx.doi.org/10.5334/ah.bt>

Published: 20 June 2011

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