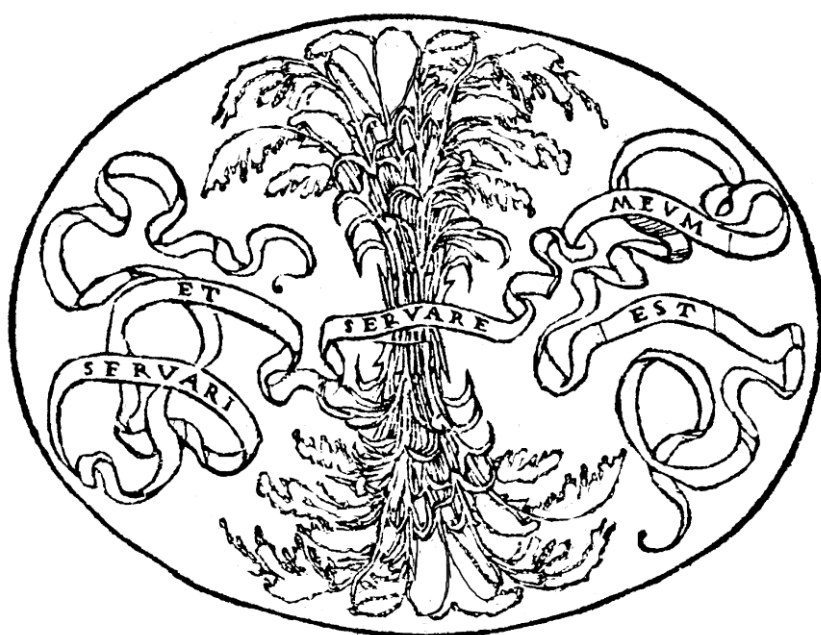


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## FILARETE'S COMPASS: RENAISSANCE TECHNOLOGIES OF *DISEGNO*

In Filarete's bronze-relief self-portrait of 1445 for the doors of Saint Peter, the Florentine artist-architect depicted himself with a circle immediately above his head, as the draughtsman's sign of the compass he holds in his hands (Fig. 1). The self-portrait may be read as an artistic signature in which the circle and the compass mark the artist's knowledge of Euclidian geometry and thus his claim to the noble attribute of artistic *giudizio*. Reputed to have been Lorenzo Ghiberti's pupil, Filarete was heir to his teacher's skill in the arts of metalwork for the *Gates of Paradise* at the Florentine Baptistery. It was also in Ghiberti's workshop that Filarete apparently gained his Greek pseudonym to signify his love of *virtù*. Thus, in Filarete's signature relief for his own great doors in Rome, the artist placed his self-portrait under the sign of the compass in order to claim a mathematical foundation for the arts of *disegno* in his name<sup>1</sup>.

Such fifteenth-century conceptions of *disegno* bring out a mathematically-derived orientation to the term shaped by the exigencies of perspectival design for the purposes of architectural projection that continued to be both residual and contested within its subsequent early modern formulations. The late sixteenth-century texts of Giorgio Vasari, G.B. Armenini, and Federico Zuccari, in their leading discussions of this critical term, were thus heirs to an early Renaissance geometer's conceptualisation of the arts of *disegno*. Tied to the development of mathematical perspective arising first in fifteenth-century architectural renderings, such a geometer's definition would be variously reflected, refuted, and reframed over the following century. Consequently, artistic tracts of circa 1600 in the wake of Vasari debated a conflicted nest of definitions of *disegno* deriving from the longer history of the term. Howsoever united under the broad sign of thought – as *giudizio*, *ingegno*, *idea*, *concetto* – *disegno* or design was married with its manual practice through drawing, also termed *disegno*, which was understood as its visible manifestation. This theoretical conceptualization of *disegno* as both idea and graphic sign, as it was defined by Vasari and Zuccari, enjoyed close connections with the Florentine and Roman academies of the arts. Born under its aegis, *Disegno* was their titular appellation. Within academic instruction, these theorists of art understood drawing as a key form of pedagogy, and the means for the acquisition of visual knowledge of all kinds<sup>2</sup>. The lesson is exemplified in the Jesuit François d'Aguilon's pedagogical tract on the mathematics of optics with illustrations by Rubens of 1613 (Fig. 2). Here Rubens demonstrates the projection of a sphere – represented by the geometric configuration of circles within an armillary sphere – into the flat plane of drawing through the computation of a cherub's compass, to illustrate the geometry of his art<sup>3</sup>. Within academy instruction, mathematical perspective was not simply a technique by which to forge volumetric objects within pictorial space, but the instrumental matrix of a conception of art founded in mimesis<sup>4</sup>.

In keeping with this volume's focus on historical theorizations of *disegno*, this essay casts back to fifteenth-century definitions arising with the early development of mathematical perspective, on the one hand; and on the other, to the ever-widening artistic practice of drawing across the *Cinquecento*. New technologies of printing and the subsequent burgeoning

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The research for this article arises from a larger project funded by the Leverhulme Trust, *The Mirror of Art: Painting and Reflection in Early Modern Visual Culture*. In respect of the wide scope of this essay, references to further scholarship given in the notes is of necessity limited to the most pertinent works, which readers can use to access adjacent bibliographies.

<sup>1</sup> HUB 2018; GLASS 2012; HUBERT 2003.

<sup>2</sup> From a vast literature on shifting and polysemous conceptualisations of *disegno* in the 16<sup>th</sup> century see the recent summary by THOMAS 2013.

<sup>3</sup> AGUILON 1613, p. 452, frontispiece; BERTRAM 2016; DUPRÉ 2008; ZIGGELAAR 2008.

<sup>4</sup> From a vast literature on perspective see especially PANOFSKY 1991; EDGERTON 1975, 2009; KEMP 1978; DAMISCH 1994; *THE TREATISE ON PERSPECTIVE* 2003; BELTING 2011; *PERSPECTIVE AS PRACTICE* 2019.

of paper production revolutionized artistic practice, and academic training, in which drawing – *disegno* – became the key method and pedagogy. This paper argues for a theorization of the image as *disegno* arising in the first instance from the architectural need for certifiably accurate building designs that could be used for the purposes of construction. As scholars have long noted, Brunelleschi was an experienced surveyor. Sources relate that he spent several years in Rome in his youth with Donatello, recording the measurements of antique buildings in order to draw their ground plans, and so was in full possession of the ancient skills and methods of architectural surveyance<sup>5</sup>. Similarly, Raphael's celebrated letter to Pope Leo X speaks to the continuing importance of architectural surveys of Rome's ancient edifices conducted according to geometrical theory, whose instrumental method was the compass. Raphael's larger point was to distinguish the technical *disegno* of the architect from that of the painter-humanist, of which the former was bound to a certifiable accuracy<sup>6</sup>. Out of this context of architectural surveying stemmed a conceptualization of drawing, or design, as a technically verifiable mimetic image, realized through the geometry of perspective, and manifest in the draughtsman's practice. In Leon Battista Alberti's 1435 consideration of the term, *disegno* represented a 'window-frame' through which the draughtsman views the subject he wishes to represent. Himself an architect, Alberti's theorization of *disegno* signified the pictorialisation of space and volume within the square of a sheet of paper through the conceptual matrix of a perspectival geometry, as in Rubens' optical demonstration print. Others – Brunelleschi, and later Leonardo – further conceived of the Albertian window-view as a mirror reflection of the visible field. In the pictorializing reflection of the mirror, space and volume appeared to the draughtsman already translated into two-dimensional form. Indeed, Alberti had also understood the origins of painting to lie in a mirror reflection, *ad fonte*, cast within the sylvan pool of the Narcissus myth. Hence the conceptualization of *disegno* as a specular metaphor took broad root across the arts of architecture, sculpture, painting, and drawing. The intention of this essay, as the examples of Filarete, Brunelleschi, Alberti, and later Dürer and Leonardo will demonstrate, is to argue that the metaphor of the Renaissance perspectival image as a mimetic mirror was founded in the very instruments of its making<sup>7</sup>.

### *The mirror-image*

Filarete's copious *Libro architetonico*, written in the 1460s, offers a considered reflection towards a theory of the image as a mirroring simulacrum founded in the practice-based methods and instruments of its production. His conceptualisation of the mimetic image arises precisely in his account of the historical development of *disegno* in terms of perspective, which he understood as the science of vision: «Egli [il disegno] è vero, niente di meno... non è cosa vera... è una dimostrazione di quella cosa che tu ritrai o che vuoi dimostrare»<sup>8</sup>.

In so saying Filarete offers a full theorisation of the image as a visual deceit, acknowledging the counterfeit of mimetic art as both truth and illusion. The capacity to represent visual 'truth' within the flat plane of the draughtsman's *disegno* lies precisely in the skill of its deception. Notably, the passage issues from Filarete's discussion of Brunelleschi's

<sup>5</sup> MANETTI/TOESCA 1927, pp. 9-13; VASARI/BETTARINI-BAROCCHI 1966-1987, III, pp. 142-144.

<sup>6</sup> Raphael to Leo X with Baldassare Castiglione, Ms. 1519 ca, Archivio di Stato Mantova, Ms. Acquisto Castiglione 2016, 2:12; Bayerische Staatsbibliothek Munich, Ms. cod. it. 37b; DI TEODORO 2003.

<sup>7</sup> ALBERTI/GRAYSON 1980, pp. 36-37, 46-47. On the extant autograph Alberti manuscripts in both Italian and Latin see GRAYSON 1968; and Rocco Sinisgalli's introduction in ALBERTI/SINISGALLI 2011, pp. 3-14. On architectural drawing and fifteenth-century geometrical perspective, DAMISCH 1994 and KEMP 1990. On mirrors and painting, WARWICK 2016.

<sup>8</sup> FILARETE/FINOLI-GRASSI 1972, II, chap. XXIII, p. 657. From a now-extensive literature on Filarete see MÜLLER 2019 and HUB 2020.

celebrated demonstration of the architect's perspectival image undertaken at the door of Florence Cathedral looking on to the Baptistery, 1415-1420 ca. Key to Filarete's account of Brunelleschi's scientific demonstration of geometrical perspective is the conceptual means of its instrumentation. For Brunelleschi's proof of the visual accuracy of his perspectival system and so of the geometer's certifiable image was a mirror, as the authenticating evidence of his claim. Thus, the mirror reflection served as the technological instrumentation of *disegno* within a Renaissance theory of the image as specular mimesis.

The genesis of Brunelleschi's experiment came from his work as an architect. His aim was to give visible demonstration of the representational accuracy of graphic perspective, in itself an abstraction of mathematical geometry notated through drawing founded in the science of optics. His purpose was to prove visually as well as mathematically that the representation of architecture in drawing according to the principles of geometrical perspective was scientifically reliable. This comprised the critical geometrical ability to work to scale through drawing or architectural rendering. In reduction or enlargement, translating between two- and three-dimensional representation, from drawn ground plans into models, and then buildings, the architectural draughtsman was tasked with designing a technically reliable drawing of a building that could be used as a template for construction. In surveying the buildings of antiquity Brunelleschi worked in reverse: that is, he used the methods of architectural surveying to effect a geometrically accurate representation of a building in the form of a drawing that was understood, in practice-based terms, as a fully realised representation<sup>9</sup>.

Cutting through a swathe of scholarly hypothesis and reconstruction of Brunelleschi's experiment: apparently standing inside the Duomo looking out at the Baptistery, Brunelleschi painted a small demonstration panel of the scene as framed by the doorway, matching the size of a mirror that he used to reflect the scene back to himself. Such a workshop mirror of this date was likely made of burnished steel fashioned into a square plane; thus Brunelleschi clearly conceived of the painted panel and the mirror as a mimetic pair. According to established methods of architectural surveying, Brunelleschi used the mirror reflection of the view as his template for a pictorial translation into the two-dimensional and reduced size of his painted panel. At the centre of his panel Brunelleschi made a small eyehole in the form of a visual pyramid: that is, a pinpoint on the painted side widening conically to accommodate the viewer's eye on the reverse. When the viewer stood inside the Cathedral doors facing out at the view of the Baptistery, as Brunelleschi had done when painting it, and peered through the panel's small eyehole from the back, s/he saw the panel's reflection in the facing mirror, made to look just like the view itself<sup>10</sup>. In this pictorial experiment, Brunelleschi's claim was that perspectival rendering could perfectly reproduce the visible world, as if in a mirror reflection. Perspective was now at the very foundation of art's mimesis, and its proof was the mirror-view<sup>11</sup>.

A key account of Brunelleschi's demonstration of perspective comes from a biography of the artist written in the 1480s by the Florentine scholar-mathematician and architect Antonio di Tuccio Manetti. Manetti brings out the interplay between geometry, optics, and architectural surveying that underpinned Brunelleschi's historic realisation of pictorial perspective<sup>12</sup>. A series of illustrations by the seventeenth-century print-maker and perspectivist Abraham Bosse in plates for the French architect-mathematician Girard Desargues' 1648 treatise on perspective for the students of the French Académie explicate the theorem in visual form (Fig. 3). Such visualisation of early Renaissance perspectival theory awaited the

<sup>9</sup> MANETTI/TOESCA 1927, pp. 9-13; VASARI/BETTARINI-BAROCCHI 1966-1987, III, pp. 142-144.

<sup>10</sup> Brunelleschi's experiment is discussed in virtually all accounts of Renaissance perspective; on the lost panels see GRAVE 2010; and for a different point of view, GENTIL BALDRICH 2013.

<sup>11</sup> On the cultural history of mirrors see MELCHIOR-BONNET 2001; *THE MIRROR IN MEDIEVAL AND EARLY MODERN CULTURE* 2016; *THE BOOK OF THE MIRROR* 2007; SHUGER 1999; and on their uses by artists, WARWICK 2016.

<sup>12</sup> MANETTI/TOESCA 1927, pp. 9-13.

further development of the printing press and the technical image, thus appearing in publications long subsequent to Brunelleschi's demonstration<sup>13</sup>. While they are not coterminous yet they evidence the extended temporal arc of Brunelleschi's geometric paradigm for the perspectival image. As Manetti describes it in his text, the design of Brunelleschi's conical eyehole was surely intended to correspond to a classical understanding of vision as a pyramid of light rays, which formed the basis of Euclidian optical science. This conceptualisation of vision had received further elaboration among subsequent ancient authors on optics, in the writings of Ptolemy and Lucretius among others. Light's conduct was seen to be manifest in the related science of mirror reflection, or catoptrics, which was understood as the basis of the science of light, as well as the foundation of pictorial representation. Mapping perspective onto a pyramidal understanding of sightlines as coterminous with the conduct of light rays bound the theory of the image to that of Euclidian vision. In its manifold history of translation as of manuscript transmission, and of eventual publication in the 16<sup>th</sup> century in myriad languages, Euclid's text would come to be titled as often *Optics* as *Perspective*<sup>14</sup>. In this historical confluence of terminology, sight and the science of light were fused, in a lexical but also practical elision stemming from the vast range of applied uses for perspectival imagery, from cartography to architecture and engineering. The ability to construct a visual pyramid marking the passage of light into the perspectival recession of space on the surface of a reflecting mirror was understood as the catoptric proof of both optical and perspectival science alike. In Brunelleschi's historic demonstration at the door of the Florentine Cathedral, perspective was now both the science of optical vision and the pictorial method of artistic practice. The classical conception of the image as a simulacrum drew together by analogy the view through a window, the mirror reflection, and the art of painting, just as Brunelleschi had shown. His experiment may thus be read as a visual demonstration of Euclid's optical theory of the specular image.

Whether with reference to Euclid or otherwise, Filarete further suggests that Brunelleschi's experiment arose through practice-based visual observation specifically predicated on the use of mirrors. The passage follows on from an earlier discussion of the use of compasses for the proportional 'sizing' of different objects to be drawn within architectural plans and preparatory compositions for paintings. Thus, the compass and the mirror are in Filarete's view twin instruments of the draughtsman's perspectival practice. After discussing the compass, Filarete then adds:

Se volessi ancora per un'altra più facile via ritrarre ogni cosa, abbi uno specchio e tienello inanzi a quella cotale cosa che tu vuoi fare. E guarda in esso, e vedrai i dintorni delle cose più facili, e così quelle cose ti saranno più appresso, e quelle più lunga ti parranno diminuire. E veramente da questo modo credo che Pippo di ser Brunellesco trovasse questa prospettiva, la quale per altri tempi non s'era usata<sup>15</sup>.

In so saying, Filarete makes direct the connection between the practice of architectural survey drawing, and the geometrical theorisation of perspectival design, at the heart of Brunelleschi's experiment. Further, Filarete underscored that the means to its realisation lay in the pictorializing instrument of the mirror reflection, which could then readily be transcribed into drawing. Throughout Filarete's text, the draughtsman's sheet of paper is also described as a window or a mirror, demonstrating the depth of the analogy in both the theory and practice of *disegno*.

<sup>13</sup> *THE TREATISE ON PERSPECTIVE* 2003, p. 9, as exemplified in ALBERTI/GRAYSON 1980, which was first published in Basel in 1540 from Alberti's Latin manuscript, though Alberti does acknowledge his use of diagrams to illustrate his theorem (cf. *ivi*, p. 75). On Bosse see GOLDSTEIN 2012 and *LES RÈGLES ET LES MANIÈRES* 2016; on Desargues, *DESARGUES* 1994.

<sup>14</sup> SINISGALLI 2012.

<sup>15</sup> FILARETE/FINOLI-GRASSI 1972, II, chap. XXIII, p. 657.



This elision of *disegno* with the window- or mirror-image was explicitly illustrated in texts of instruction for the apprentice draughtsman such as Hieronymus Rodler's *Eyn schön nützlich Büchlin und Underweisung der Kunst des Messens* of 1531, and subsequently in publications such as Bosse and Desargue's 1648 manual on perspective (Figs. 3-4). In practice, the technological means was the drawing grid or squaring device. Like Rodler's illustration, Filarete's advice is to 'square' a sheet of paper in a mirror-image of the view to be depicted, seen through a corresponding grid of string lines. By means of the squaring grid the draughtsman might, with the use of a ruler, draw together the points of a perspectival recession into convergent orthogonal lines. These are, Filarete explains, like the pyramidal lines of vision projected into the image. These lines will converge at a central point, termed by Renaissance surveyors the 'certification point', in recognition of its geometrical accuracy; and by students of optics and geometry the centre point, or the mathematical point of infinity, at which the horizon narrows to a point marking the furthest reach of the pyramid of vision<sup>16</sup>. For a proof or demonstration of this geometry it is signal that Filarete advocates Brunelleschi's mirror:

E se meglio vuoi considerare, torrai uno specchio e guarda dentro di esso: vedrai chiaro esser cosi; e se ti fussino al dirimpetto l'occhio, non ti parrebbero se non tutti uguali. E cosi credo che Pippo di ser Brunellesco fiorentino trovasse il modo di fare questo piano, che veramente fu una sottile bella cosa che per ragione trovasse quello che nello specchio ti si dimostra, benché coll'occhio ancora, se ben considerrai, tu vedrai quelle mutazioni e diminuzioni<sup>17</sup>.

Here it is clear that, as with Brunelleschi's demonstration panel of the Baptistery, geometrical perspective is understood as visually interchangeable with the view through a window, and its pictorial translation by means of a mirror reflection. This is also the visual argumentation of Rubens' illustration of perspectival projection for Aguilon, in which the circular configuration of the armillary sphere is cast into the two-dimensional plane of drawing by means of reflected light (Fig. 2). It brings together the tripartite method of proof deployed by Brunelleschi at the Cathedral door: window, mirror, painting. The sequential relationship between window view, mirror reflection, and *disegno* runs as a continuing thread through the history of perspectival geometry in Renaissance art theory and practice. Following Brunelleschi's experiment, as scholars have successively noted, both the visual geometry of perspective and the understanding of drawing and painting as a form of mimetic specular 'truth' takes root. This is manifest on the one hand in Masaccio's geometry of foreshortening in the great *Trinity* fresco 1425 ca; and on the other, the studied specular reflection of receding spatial depth in Jan van Eyck's Arnolfini glass tondo mirror reflection of 1434<sup>18</sup>. Thus the early Renaissance theorisation of a specular mimesis was intertwined with mathematical perspective, as geometry and catoptrics became increasingly elided within the pictorial process of *disegno*. This is aptly summarised in Cesare Ripa's emblematic pictorialisation of *disegno*, in his *Iconologia*, in which the figure of *disegno's* *virtù*, like Filarete, holds the compass of mathematical measurement in one hand, with the mirror of optical science in the other<sup>19</sup>. As heir to both catoptric and geometrical theorisations of the image, Federico Zuccari would also cite the mirror as a metaphor of his art, in his 1607 *Idea de' Pittori*. Linked to the idea of nature itself as a reflection

<sup>16</sup> Panofsky argued the case for one-point perspective as symbolic of visual 'reality' (cf. PANOFSKY 1991); while Gombrich argues for an historical process of artistic 'matching' of art to the visible field (cf. GOMBRICH 1960). The precise delineation of Renaissance perspective remains contested; see further Christopher S. Wood's introduction to his translation of *Die Perspektive als 'symbolische Form'* by Panofsky (WOOD 1991); DAMISCH 1994; ELKINS 1994, *THE TREATISE ON PERSPECTIVE* 2003; BELTING 2011; *PERSPECTIVE AS PRACTICE* 2019.

<sup>17</sup> FILARETE/FINOLI-GRASSI 1972, II, chap. XXIII, p. 653.

<sup>18</sup> For recent discussion of Eyckian optics see VAN EYCK 2020; LEONARDI 2019; HANLEY 2007; on Masaccio's *Trinity*, CAMEROTA 2019; MEY 2012; AIKEN 1995.

<sup>19</sup> RIPA 1618, I, *Disegno*, pp. 142-144; *L'ICONOLOGIA DI CESARE RIPA* 2013; ENENKEL 2019.

of the infinite divine, Zuccari famously conceived of *disegno* as *segno*. In so saying, Zuccari defined the nature of painting as both deceit and verity, like a mirror reflection, whose verisimilitude lies in the skill of its specular fiction<sup>20</sup>. From the legacy of Filarete's circle and compass, Brunelleschi's mirror-image and Alberti's window-view, Zuccari's theorisation of *disegno* as sign was founded in a mathematical semiosis of the image deriving from the rise of linear perspective as the matrix of a specular and mimetic art.

### *The Practice of Perspective*

As Van Eyck painted his Arnolfini mirror in Bruges, in Florence Alberti was writing his great theorization of the art of painting, *Della pittura*, founded in Brunelleschi's methods. Indelibly bound up with the development of geometrical perspective as the new structuring logic of the mimetic picture plane, Alberti's treatise, following Brunelleschi's example at the Cathedral door, famously conceived of the arts of *disegno* as an open window. This analogy between *disegno*, mirrors, and the picture as a window-view, at play in the depiction of the window alongside the mirror within the Arnolfini portrait's painted reflection, was already at work in Brunelleschi's conceptualization of architectural drawing as the view through a doorway, transposed into the reduced size of a painting and a mirror.

The widespread adoption of the window motif within Renaissance art theory, as an Albertian paradigm of the pictorial arts, would become a parallel to the specular metaphor of drawing and painting and an equivalent definition of *disegno* as the art of mimesis. At the same time, like his friend Brunelleschi to whom he dedicated the Italian edition of his book, Alberti also understood the picture plane in terms of the technology of its making. He theorized the plane as what he termed the 'intersection' between the viewer and subject depicted, which he characterized as a perspectival grid standing at a midpoint between, and intersected by, on the one side the viewer's rays of vision and on the other the converging lines of pictorial space. The long history of re-editions of Alberti's text across the 16<sup>th</sup> century, newly accompanied by diagrammatic illustrations of his Euclidian theorization of the image, is testament to its continuing place within all subsequent discussion of *disegno*.

In his practice Alberti advocated the use of a framed grid or squaring device such as Filarete described and Rodler illustrated, to embody his conceptualization of the picture plane as an intersection of the rays of vision. In effect this became the technological means of visualizing a Renaissance *disegno*. Standing between the artist's eye and the objects to be depicted, the grid acted like the view through a window or doorway, and the draughtsman's equivalent to a mirror reflection. By means of the squaring device the artist could frame the composition, using it to transpose the perception of the world into two dimensions. Alberti constituted this grid as a workshop-based device made out of a transparent veil of very finely woven cloth like muslin, marked out by parallel lines in a larger thread:

[...] nulla si può trovare, quanto io estimo, più accomodata cosa altra che quel velo, quale io tra i miei amici soglio appellare intersegazione. Quello sta così: egli è un velo sottilissimo, tessuto raro, tinto di quale a te piace colore, distinto con fili più grossi in quanti a te piace paraleli, qual velo pongo tra l'occhio e la cosa veduta, tale che la piramide visiva penetra per la rarità del velo [...] Ultimo a te darà il velo molto aiuto ad imparare dipingere, quando vedrai nel velo cose ritonde e rilevate...<sup>21</sup>

<sup>20</sup> ZUCCARI 1607, book I, pp. 6-7. On Zuccari see TADDEO AND FEDERICO ZUCCARO 2007; FEDERICO ZUCCARO 2000; DER MALER FEDERICO ZUCCARI 1999; ACIDINI LUCHINAT 1998-1999; and the extensive historiography of the *Idea* issuing from the fundamental PANOFKY 1968.

<sup>21</sup> ALBERTI/GRAYSON 1980, pp. 54-56. On Alberti's window-frame see EDGERTON 2009, pp. 126-132; MOFFITT 2002; PARDO 1997.

Like Brunelleschi's mirror, Alberti's intersection was both an instrument of artistic production, and a virtual simulacrum of the work of art in the making. The conflation of the picture plane with the workshop instruments of a mimetic art heightened the proximity between *disegno* as representation, and the processes of its own production. Thus, theory arose in the material instrumentation of practice.

*How the mirror is the master of painters*

The meeting of art and science in Leonardo's notebooks is nowhere more in evidence than in his discussions of mirrors, seemingly part of an intended treatise in its own right as well as in relation to his planned book on perspective<sup>22</sup>. Most profoundly he understood the mirror as a parallel to artistic representation in its ability to capture the illusion of all visible things in its reflecting sheen. His longest discussion of the artist's use of the mirror occurs as part of his intended treatise on painting. In a passage titled *Come lo specchio è il maestro dei pittori* he argued: «Un'immagine è una singola superficie, e lo specchio è lo stesso»<sup>23</sup>. Theorization of the picture plane in terms of a mirror is here fully intertwined with its practical application.

Elsewhere, Leonardo described the use of a drawing frame, clearly an Albertian window-grid, through which to draw in correct perspectival recession, as in a mirror reflection:

Se ti vuoi assuefare bene ai retti e buoni posati delle figure, ferma un quadro ovvero telaio, dentro riquadrato con fila, infra l'occhio tuo e il nudo che ritrai, e quei medesimi quadri farai sulla carta dove vuoi ritrarre detto nudo sottilmente; di poi poni una pallottola di cera in una parte della rete, che ti serva per una mira, la quale sempre nel riguardare il nudo scontrerai nella fontanella della gola, e se fosse volta di dietro, scontrala con un nodo del collo; e queste fila t'insegneranno tutte le parti del corpo che in ciascun atto si trovano sotto la fontanella della gola, sotto gli angoli delle spalle, sotto le tette, i fianchi ed altre parti del corpo [...] I quadri disegnati possono essere tanto minori che quelli della rete, quanto tu vuoi che la tua figura sia minore che la naturale<sup>24</sup>.

Whereas Alberti's account focused on the use of the grid from which to draw perspectival orthogonals of spatial recession, as in Filarete's description of the lozenge-like configuration of pavement squares to indicate the illusion of depth, Leonardo instead describes the use of the squaring device to render the volume of bodies. 'The pit of the throat, the angles of the shoulder' – Leonardo centres on the parts of the body involving particularly complex shading to render the visual illusion of their undulating form. The purpose of the correspondence between the squaring device and the squared paper is to enable a diminution in scale as well as accuracy in proportions throughout the process of converting visual perception into the flat plane of a drawing. In this regard it functions as a parallel form to the mirror reflection of

<sup>22</sup> As suggested in Leonardo's notes, Milan, Biblioteca Ambrosiana, *Codex Atlanticus*, fol. 250r b, as noted in *THE LITERARY WORKS OF LEONARDO DA VINCI* 1977, II, p. 130.

<sup>23</sup> Bibliothèque Nationale Paris, Leonardo Ms. 2038, fol. 24v, cited in *THE NOTEBOOKS OF LEONARDO DA VINCI* 1938, II, p. 254; BAMBACH 2019, I, pp. 52, 311. From a vast literature on Leonardo's notebooks and their complex anthological history see BAMBACH 2019; *LEONARDO DA VINCI'S CODEX LEICESTER* 2019; FARAGO–BELL–VECCE 2018; the useful summary in *LEONARDO DA VINCI* 2006, pp. 207–208; *LEONARDO ON PAINTING* 1989. Due to the great historical complexities of anthological arrangements of Leonardo's notes, initiated by the artist himself, his subsequent heirs, and thereafter by scholars and editors, the many editions and translations, as well as repetition within the notes themselves made over his lifetime, I have cited directly from the manuscripts with attendant references to published editions. On Leonardo's interests across arts and sciences see especially KEMP 1981; *LEONARDO DA VINCI* 2006; KEMP 2004; for his interests in the representation of ephemeral effects see NOVA 2011.

<sup>24</sup> Bibliothèque Nationale Paris, Leonardo Ms. 2038, fol. 24r, cited in *THE NOTEBOOKS OF LEONARDO DA VINCI* 1938, II, p. 254.

Brunelleschi's demonstration, able to reduce in scale as well as to pictorialize, by translating the third dimension into two-dimensional form.

The notebooks suggest that, in Leonardo's practice, the mirror increasingly came to take the place of the grid. While Alberti advocated the use of a mirror as a means of comparison and correction, Leonardo integrated it more profoundly into the ongoing development of pictorialized representation. Like Brunelleschi, he deployed a mirror to reflect the subject of representation in order to transcribe it onto the canvas in much the same way that Alberti's artists worked from what they saw through the squaring device. Thus, Leonardo made the mirror the primary instrument of artistic mimesis. Further, the dimming reflection of the Renaissance mirror offered Leonardo a reduction of local colour into a unifying scale of tonal gradations in concert with his analytical understanding of atmospheric perspective. The shift from a *Quattrocento* representation of perspectival spatial recession to that of a Leonardesque volumetric conception of pictorial depth may be joined to Leonardo's broader reconceptualization of perspective as both atmospheric and linear and so of art itself<sup>25</sup>.

Throughout his notes Leonardo advocated the artist's mirror as a 'thinking mirror', not merely a mimetic one, asking the painter to imitate its reflection through practice and the judgment of the eye coupled with the use of reason, for it is the «*maestro dei pittori*». Elsewhere Leonardo so fused his art with the mirror that he urged the artist to liken his mind to its surface: «L'ingegno del pittore vuol essere a similitudine dello specchio, il quale si trasmuta... e di tante similitudini si empie, quante sono le cose che gli sono contrapposte»<sup>26</sup>. Thus Leonardo touched on the related issue of artistic memory, predicated on imitation, which he understood as a compendium of 'mirror' images. He advocated training the artist's visual memory through the repeated practice of drawing, conceptualized as a specular form of imitation. Both the concept and the method of mirror-memory would become instrumental to artistic training in sixteenth-century academies precisely through the medium of drawing, such that *disegno* was tutor to art's memorative capacities. Leonardo touched on the practice of drawing as the instrument of a mirroring mimesis both in terms of the sketchbooks he advised the painter to carry with him, as he always did himself; and as the instrument of an artist's academic study conducted through a practical *disegno*. This is to suggest an equivalence between the mirror metaphor and the medium of drawing under the sign of *disegno*, which Leonardo directly counselled for the formation of artistic memory, advising artists to draw constantly: «Sempre il pittore che vole avere onore delle sue opera, debbe cercare la prontitudine de' sua atti negli atti naturali fatti dalli omini improvviso... e di quelli fare brevi ricordi in su' suoi libretti...»<sup>27</sup>. In the studio, Leonardo advised drawing as a form of study practiced through the use of various mirror-like instruments, through which to train the judgment of the hand and eye. These included, as pictured in a sketch among his notes in the *Codex Atlanticus*, an 'exemplar' traced on to a thin flat plane of glass, which the artist was then instructed to place on top of his drawing, noting carefully where the tracing did not match the sketch (Fig. 5)<sup>28</sup>. His device is a flat upright pane, like a window or a sheet mirror, on which to trace the outlines of what he saw. Recalling its theorization as a perspectival instrument, Leonardo termed it a 'perspectograph'. In

<sup>25</sup> From a vast literature see *LEONARDO ON PAINTING* 1989, pp. 47-116, especially on the ordering of Leonardo's notes around themes of perspective and the relation between linear, colour and atmospheric perspective; see also ZWIJNENBERG 1999 and *RE-READING LEONARDO* 2009.

<sup>26</sup> Biblioteca Ambrosiana Milan, Leonardo Ms. *Codex Atlanticus*, fols 76r a, 184v c, 505v; Bibliothèque Nationale Paris, Leonardo Ms. 2038, fol. 2r; *THE LITERARY WORKS OF LEONARDO DA VINCI* 1977, I, pp. 183-184; *LEONARDO ON PAINTING* 1989, p. 205; *THE NOTEBOOKS OF LEONARDO DA VINCI* 1938, II, p. 235.

<sup>27</sup> Biblioteca Apostolica Vaticana, Leonardo, *Libro di pittura*, Ms. *Codex Urbinas* 1270, 1540 ca, pp. 2, 49; *LEONARDO DA VINCI/PEDRETTI-VECCE* 1995, II, pp. 127, 200.

<sup>28</sup> Bibliothèque Nationale Paris, Leonardo Ms. 2038, fol. 24r; Biblioteca Apostolica Vaticana, Leonardo Ms. *Codex Urbinas* 1270, fol. 37v; *LEONARDO ON PAINTING* 1989, p. 206. See further KEMP 1990, especially pp. 170-171, and the compendium of Leonardo's notes on painters' aids in *LEONARDO ON PAINTING* 1989, pp. 191-217.

Leonardo's sketch, a seated draughtsman draws after a globe-shaped armillary sphere, an astronomical model of the circuits of the planets used to derive mathematical measures of space and time. As also in the Rubens print, the armillary sphere was acknowledged as particularly adept to a draughtsman's training in the ability to translate a complex three-dimensional object into its illusionistic rendering on a flat plane. Above, Leonardo's reverse 'mirror' writing denotes the diagram. It is the depiction of the instrument through which the draughtsman views the sphere, bringing together Leonardo's converging interests in the Albertian problem of perspective and the practice of the picture plane. In order to render the visual appearance of the armillary's spherical volume into the two-dimensional surface of a diagram, the draughtsman works by means of the vertically-placed glass pane. The artist looks through a sighting device, to steady the eye, onto a framed pane of glass placed before the object to be depicted. By this means the perspectograph allows the draughtsman to establish the outline and geometrical relation of the parts directly onto the glass before him. In effect, the perspectograph is a window-frame medium of translation, like perspective itself, through which the draughtsman maps the volumetric outline of a complex spherical volume onto a flat plane. Thus, in Leonardo's practice the glass plane takes the place of the Albertian intersection or window through which to draw, as a direct equivalent to a Brunelleschian doorway and mirror reflection. Through its glass field of vision Leonardo's draughtsman can compare his drawing on paper with the view itself. It is a practical application of Alberti's conceptualisation of a painting as a planar intersection of the visual pyramid of rays between the viewing eye and the field of vision. Further deepening the analogy between the glass pane and the plane of intersection, Leonardo argued:

La prospettiva non è altro che vedere uno sito divieto uno vetro piano e ben trasparente sulla superficie del quale siano segnate tutte le cose che sono da esso vetro indietro le quali si possono cõdurre per piramidi al puto dell'occhio e esse piramidi si tagliano sudetto vetro<sup>29</sup>.

Leonardo's glass pane is Alberti's theoretical window in material form.

Collectively, Leonardo's notes on the mirror and the glass pane theorize their conceptual equivalence with perspectival drawing as well as their practical use as instruments of imitation. This in turn drew on his larger interests in optics, the science of reflected light, and the relationship between reflection and vision. Throughout his practice and in his notes, Leonardo thus knit together by analogy the window with the mirror, likening them both to his art. As with Brunelleschi's demonstration at Florence Cathedral, Renaissance artists and theorists made practical metaphor of their mimetic art through the instruments of its making. Window, mirror, drawing grid, and pictorial image, are visible and conceptual equivalents for the theory and practice of Renaissance *disegno*.

### *Alberti's window*

As Leonardo was collecting his notes for an intended treatise on painting, Dürer was preparing his multi-volume work on artistic measurements, the *Underweysung der Messung, mit dem Zirckel und Richtscheit* (1525)<sup>30</sup>. Much criticized by Armenini and Zuccari, this treated the geometry of figural forms in art, and specifically the mathematically proportional

<sup>29</sup> Institut de France Library Paris, Leonardo Ms. book A, fol. 1v, cited in *THE NOTEBOOKS OF LEONARDO DA VINCI* 1938, II, p. 369.

<sup>30</sup> DÜRER/STRAUSS 1977; PANOFSKY 1943, I, p. 257; Panofsky references use of both the grid and the glass pane method (cf. PANOFSKY 1915, p. 41). See further CACHE 2016; SCHRÖDER 1980; and Dürer's book of proportions DÜRER/HINZ 2011.

representation of complex volumes in the two-dimensional medium of drawing. Their criticism centred precisely on the incursion of mathematic calculation through the use of the architect's ruler and compass, at the expense of the artist's *giudizio dell'occhio* in Michelangelo's felicitous phrase; or the tension between measurement and the mirror as the matrix of Renaissance visual imitation which would later configure the dispute on perspective at the French Académie between Bosse and Desargues and its then-director, Charles Le Brun<sup>31</sup>. At the close of the *Messung* Dürer included a page of illustrations depicting an artist drawing after a three-dimensional object through the use of various glass pane or grid instruments (Fig. 6). As with Brunelleschi's mirror, Alberti's grid, and Leonardo's glass exemplar, which Dürer surely knew, this technological apparatus was the means for translating the appearance of volume into two dimensions. In the upper illustration, a draughtsman draws the outline of a vase onto an upright sheet of glass framed like a picture, or indeed a window, using also a sighting device to keep the position of the viewing eye constant. The sighting device corresponds to the point of the visual pyramid as a mirror reflection of the 'centre' point within the perspectival image. These devices embody the Albertian concept of the 'intersection' in material form, for the distance between the viewing eye, the panel, and the object to be depicted effect the same transpositions of perspectival distance as the corresponding grid of the draughtsman's squaring device. Like a preparatory drawing, the outline on the glass forms the first stage in the artistic translation of the world into the flat field of drawing and painting. As with Leonardo's description and sketch of his glass exemplar, Dürer's illustrations visibly demonstrate the use of a range of optical devices in Renaissance artistic practice to facilitate the translation of observed volume and space into the illusion of drawing's *disegno*.

In this vein Dürer's lower illustration is particularly instructive. It shows a draughtsman seated at a table with a large sheet of squared paper before him on which he has begun to draw. However, his eyes do not follow his hand at this moment; rather, he looks through a sighting device onto an upright framed grid, whose squares correspond to those on the artist's sheet of paper below. Looking through the grid to what lies beyond it, we/the artist observe/s a life-size female nude awkwardly recumbent across the further half of the table, seemingly a sculpture. Clearly, the artist is using the framed grid to establish within its squares where each part of this female anatomy lies, in order to transpose its three-dimensional form onto the squares of his paper. Again, the framed viewing device – in this instance a grid – acts as the method of artistic translation from three into two dimensions. As Dürer stressed in his notes, the framed grid enabled the artist to alter the scale, rendering the imitation either larger or smaller, as wished<sup>32</sup>. Here Alberti's celebrated metaphor of the picture plane as a 'window' or intersection becomes a working instrument. Its continuing illustration in sixteenth-century prints within manuals on perspective, such as Rodler's and subsequently Bosse's, testifies to its common use within a draughtsman's practice. This history of early modern art's instruments of drawing would culminate in the extensive range and development of optical and perspectival devices described by Galileo's friend and fellow artist-mathematician Ludovico Cigoli in his *Trattato pratico*, which illustrated the growing complexity and elaboration of artists' instruments arising from Leonardo's glass and Alberti's grid<sup>33</sup>. In effect, such practice again embodies an Albertian theory of drawing and painting as a window-view. The workshop technologies of Dürer's craft are thus fully entwined with the broad conceptualization of art as a window or mirror, as Brunelleschi had demonstrated, and Alberti and Leonardo had theorized.

<sup>31</sup> On Michelangelo and the *giudizio dell'occhio* see especially the discussion by SUMMERS 1981, pp. 332-379, and WINNER 1986. On the debate between Bosse and Desargues, and Le Brun, GOLDSTEIN 2012.

<sup>32</sup> DÜRER/STRAUSS 1977, p. 435.

<sup>33</sup> CIGOLI/PROFUMO 1992; CAMEROTA 2010. On the practice of perspective see *THE TREATISE ON PERSPECTIVE* 2003; *PERSPECTIVE AS PRACTICE* 2019.

*Fatto al specchio*

The conjoined functions of the squaring device with the mirror in the years around 1500 take on a particular significance with the rise of self-portraiture. Here the use of the mirror as the technology of a mimetic process was directly instrumental to the developing configuration of this new genre. In fact, Renaissance sources did not use the term self-portrait but defined such images of the self by the instrument of their making: *'fatto al specchio* – made from a mirror'<sup>34</sup>.

Dürer's youthful self-portrait drawn in a mirror of 1484 brilliantly announces this relationship between artist and instrument in the historical development of the self-portrait (Fig. 7). It is Dürer's earliest self-portrait drawing made as a child, to which he ascribed a date forty years later: «Dz hab jch aws eim spigell nach mir selbs kunterfet jm 1484 jar do ich noch ein kint was. Albrecht Dürer»<sup>35</sup>. It is only at the later moment of his inscription that Dürer fully recognised the drawing's historical import as an essay in specular imitation of the self, for its destiny was not foreseen at the moment of its making as a child; it was then simply a workshop experiment in the mirror-methods of mimesis. The drawing is itself the size of a small Renaissance mirror, material testament to the inferred equivalence between them. Meticulously rendered in silverpoint, it records Dürer's intent gaze as he scrutinises his reflection in order to draw it, noting the slight distortion of the nose and right cheek in what must be the bowl of a convex mirror formed from blown glass. The young artist's hand is held up in what is surely an act of 'sizing'. With his fingers he gauges the dimensions of a detail of his body as seen in the mirror to capture it accurately in his drawing. Thus Filarete's mathematical sign of the compass is here within the practising 'compass' of the artist's hand and eye, which Michelangelo would later acclaim as the *giudizio dell'occhio*<sup>36</sup>. This judgment of the eye marked a transcendence from, yet still within, those mathematically-derived perspectival definitions of *disegno* of the compass and the grid, now transposed onto the artist's hand as the direct 'instrument' of the mind itself.

A red chalk self-portrait drawing by Pontormo that dates from the same moment as Dürer's later inscription shows a similar pictorial fusion between the mirror and the drawing, between viewing and making (Fig. 8)<sup>37</sup>. Here Pontormo stands in a three-quarter profile pose. With his lower arm he draws himself on a sheet of paper directly in front of him, placed just outside the image to the right. As the study of a reflection in a flat mirror Pontormo's image is reversed, with the consequence that the drawing hand appears to be left but in fact would have been right. The other hand extends forward towards the surface of the picture plane, seemingly touching it with the tips of his fingers. The lower fingers are loosely curled into the fist, while the index finger and thumb extend forward in the same gesture of sizing as Dürer. His gaze is directed towards the tips of those fingers. Like Dürer's self-portrait drawings, Pontormo is apparently measuring what he sees in a mirror, his fingers spanning a detail through the judgment of hand and eye. Pontormo would seem to practice Michelangelo's *giudizio dell'occhio* through the medium of *disegno*, to argue in drawing that the artist's true compass should lie in the judgment of the eye, rather than depending on the devices and grids that Dürer had elaborated for artisans in his treatise on measurement, the *Messung*, also of 1525.

In an example of a painting that in many respects served the function of drawing, as a visual experiment and proof of demonstration like Brunelleschi's Baptistery panel: Parmigianino's early self-portrait of 1525 (Fig. 9). Like the 1484 Dürer drawing, it is the work

<sup>34</sup> WARWICK 2021; BONAFoux 2007; FLETCHER 1992; VECCHI 1990. From an extensive literature on Renaissance self-portraiture see BURCKHARDT 1860; KOERNER 1993; WOODS-MARSDEN 1998; *SELF-PORTRAIT* 2005; CALABRESE 2006.

<sup>35</sup> KOERNER 1993, p. 43.

<sup>36</sup> SUMMERS 1981; WINNER 1986.

<sup>37</sup> Carol Plazzotta in *RENAISSANCE FACES* 2008, p. 256.

of a young adolescent, also dating to the same moment as Dürer's later inscription of his sheet, and the Pontormo sketch. Here Parmigianino rendered his image on a small convex wood panel he had fabricated to the same dimensions as the convex mirror in which he studied his face, whose tondo frame he depicts on the right. According to Vasari:

per investigare le sottigliezze dell'arte, si mise un giorno a ritrarre se stesso, guardandosi in un specchio da Barbieri di que mezzo tondi. Nel che fare, vedendo quelle bizzarrie, che fa la ritondita dello specchio nel girare, che siano le travi de' palchi, che scorcono, e le porte, e tutti gli edifizii, che sfuggono stranamente, gli venne voglia di contrafare per suo capriccio ogni cosa. Laonde fatta fare una palla di legno a tornio, e quella divisa per farla mezza tonda, e di grandezza simile allo specchio, in quella si mise con grande arte à contrafare tutto quello, che vedeva nello specchio, e particolarmente se stesso, tanto simile al naturale, che non si potrebbe stimare, ne credere. E perche tutte le cose, che s'appressano allo specchio crescono, e quelle, che si allontanano diminuiscono, vi fece una mano, che disegnava un poco grande, come mostrava lo specchio, tanto bella, che pareva verissima, e perche Francesco era di bellissima aria, & haveva il volto, e l'aspetto grazioso molto, e piu tosto d'angelo, che d'huomo, pareva la sua effigie in quella palla una cosa divina, anzi gli successe cosi felicemente tutta quell'opera, che il vero non istava altrimenti, che il dipinto, essendo in quella il lustro del vetro, ogni segno di riflessione, l'ombre, & i lumi si proprii, e veri, che piu non si sarebbe potuto sperare da humano ingegno<sup>38</sup>.

The presence of the mirror's edge within the image reinforces the visual equivalence of the circular form between them. The painting meticulously observes the distortions of the mirror's reflection caused by the rise of the blown glass. This is particularly pronounced in the lozenge-shaped window on the upper left, recognisably that of a reflection in a spherical mirror; and in the exaggerated size of the artist's hand in the foreground. Thus, the image conflates the mirror, which constitutes the instrument of the painting's production, with the material fabric of the panel on which it is painted. In this regard, it maps the practice of self-portraiture, *fatto al specchio*, onto Brunelleschi's perspectival experiment with a mirror at the doors of Florence Cathedral.

The tondo form as the sign of art recurs across a range of early modern specular self-portraits, configured variously as both mirrors and circles, from Filarete's bronze relief at Saint Peter's to Rembrandt's late self-portrait now at Kenwood House. One of some 80 self-portraits in painting, drawing, and etching from across Rembrandt's working life, it depicts the aging artist wearing a painter's smock, tabard, and linen cap, with a palette, brushes, and mahlstick in his left hand. Technical research on the picture's surface suggests this was originally sketched in with the brush in his left hand held up to the canvas, according to the direct reflection of a mirror image then transposed, so documenting materially the use of a mirror by which he composed the work. Behind him, his head is loosely positioned between the outlines of two great circles, both of which are elliptically intercepted by the canvas edge. One runs through the figure of the artist from the head through the painting arm; the other seems to encircle the canvas-within-the-canvas as the emblem of its art. The tondo form surely also suggests Vasari's account of the young Giotto, apparently discovered by Cimabue for his precocious draughtsmanship manifest in the performed execution of a perfect circle, the judgment of hand and eye thus commensurate with the mathematics of the compass-sign. For the story of Giotto's perfect circle comprised within it the artistic authority of the compass, as the tool of artists and architects but also mathematicians, following a Euclidian geometry of perspective as the sign – Zuccari's *di-segno* – of the image itself<sup>39</sup>.

<sup>38</sup> See EKSERDJIAN 2006, p. 130, for discussion of Vasari's slightly differing accounts of the painting from the 1550 to the 1568 edition of his *Vite*; see further FERINO-PAGDEN 2002 and RUBIN 2007.

<sup>39</sup> The many scholarly interpretations of Rembrandt's Kenwood self-portrait are summarised by CHAPMAN 1992, pp. 97-101. On the O of Giotto see LADIS 2008; and in relation to the Rembrandt's portrait, MOFFITT 1984.



To conclude with the sign of Giotto's O in the time of Zuccari: a preparatory drawing by Annibale Carracci shows a succession of compositional ideas for a self-portrait bound up with its own specular address in circular form (Fig. 10). To the right is a bust of a man in classical garb surmounted by a roundel. The left side is devoted to two sketches for a painting of himself. Above, he depicts himself in a three-quarter pose, his torso also enveloped in a cloak from which only his right – painting – hand protrudes, looking out to what must be his mirror reflection. To the left just above him, the same cloaked figure appears again within a tondo in reduced scale, so repeating the roundel motif on the drawing's right. Together the sheet suggests a doubled reflection of his figure, seen from behind as well as from the front. As other scholars have argued, this is surely a notation of Annibale's own reflection in a circular mirror, so identifying the specular source of his self-portrait's instrumental means<sup>40</sup>. It further suggests the domain of catoptric experiment, as Leonardo among other artists had demonstrated, following Euclid, in the study of multiple mirror reflection<sup>41</sup>. It was one to which Zuccari would return, in defining the ontological nature of painting as both present and impalpably absent, like the sheen of a mirror reflection. Summoning his reader to envisage the image of an art gallery reflected within a large mirror, Zuccari asked them to note:

Io dico, che se si pone uno specchio di finissimo cristalo, che sia grande in una sala ornata di pitture eccellenti, & di statue maravigliose, chiara cosa è, che fissando io l'occhio in quello non pure egli è termine del mio vedere, ma anco oggetto rappresentante chiaramente, & distintamente tutte quelle pitture, e statue à gli occhi miei, & pure in quello non sono quelle pitture, e quelle statue secondo la materia, & sostanza loro; ma solo in lui rilucono col mezzo delle lor forme spirituali. Così devono filosofar quelli, che vogliono intendere che cosa sia Disegno in generale, ciò è immaginarsi che si come lo specchio è termine, & oggetto del vedere, & in lui si veggono le cose risplendere. Così il Disegno è termine, & oggetto conosciuto, entro al quale conosce l'intelletto le cose in lui rappresentate<sup>42</sup>.

Annibale's drawing may be said to intimate Zuccari's equivalence of *disegno* with the mirror reflection of an art collection in its sketched sequence of would-be paintings and busts. As such it is a graphic representation of the specular image launched by Brunelleschi's paired mirror and painting at the door of Florence Cathedral, Alberti's view through a window, and the configuration of *disegno* as the instrument of optical perception at the centre of Renaissance art. Thus, its pictorial argument suggests a working definition of drawing as both theory and practice, or of *disegno* as both conceptual sign and material trace. Both the cleavage and the convergence of *disegno* as a critical term is in large part bound to a history of art-historical translation, as drawing and design are differentiated in English while in Italian they are one. It is a linguistic elision that goes to the centre of Zuccari's theorization of *disegno*, as debated with Vasari and Armenini, but also the longer history of the term within the specular geometries of *Quattrocento* perspective as this essay has sought to demonstrate. In Annibale's self-portrait drawing, Filarete's sign of the compass has become the mirror of *disegno*'s reflective art.

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Technical research on the picture's surface suggests this was originally sketched in with the brush in his left hand held up to the canvas, according to the direct reflection of a mirror image then transposed, so documenting materially the use of a mirror by which to compose. Cf. *ART IN THE MAKING* 1988.

<sup>40</sup> SPARTI 2001; WINNER 1989.

<sup>41</sup> Institut de France Library Paris, Leonardo Ms. B, fol. 28, cited in *THE LITERARY WORKS OF LEONARDO DA VINCI* 1977, I, p. 132, no. 65, with a reproduction of Leonardo's small diagram of an octagonal mirror chamber. It is also discussed by ZWIJNENBERG 1999, p. 183, as the manifestation of Leonardo's 'labyrinthine gaze'.

<sup>42</sup> ZUCCARI 1607, book I, pp. 6-7.



Fig. 1: Filarete (Antonio di Pietro Averlino), *Self-portrait with assistants*, 1445, St. Peter's Rome. Fabbrica di San Pietro in Vaticano. Photo: Wikimedia Commons



Fig. 2: Peter Paul Rubens, in François d'Aguilon, *Opticorum*, Antwerp, 1613, VI, frontispiece. Photo: Wikimedia Commons

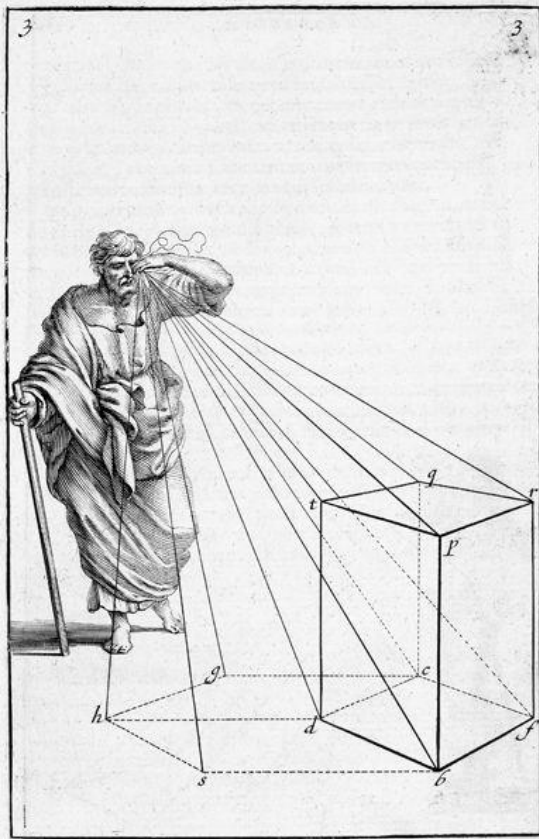


Fig. 3: Abraham Bosse, in Gerard Desargues, *Manière universelle pour pratiquer la perspective*, Paris, 1648. Photo: Bibliothèque Nationale de France, Paris

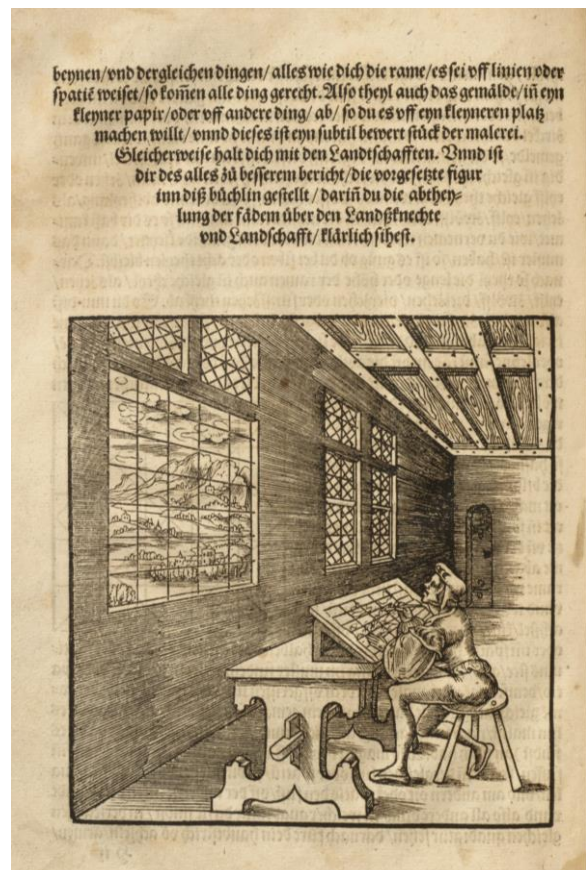


Fig. 4: Hieronymus Rodler, *Eyn schön nützlich Büchlin und Underweisung der Kunst des Messens*, Simmern, 1531. Photo: Germanisches National Museum Nuremberg



Fig. 5: Leonardo da Vinci, Draughtsman drawing after an astrolabe through a perspectograph, 1480 ca, detail of *Codex Atlanticus*, fol. 5r., Milan: Biblioteca Ambrosiana. Photo: Veneranda Biblioteca Ambrosiana

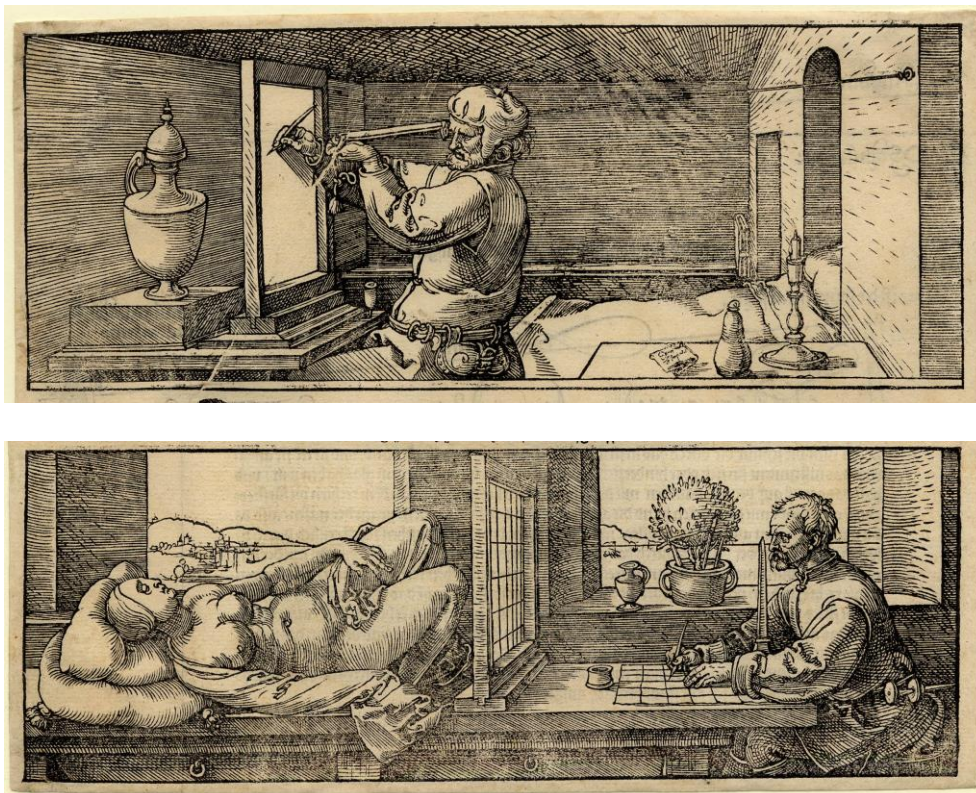


Fig. 6: Albrecht Dürer, *Unterweysung der Messung mit dem Zirckel und Richtscheit*, Nuremberg, 1525. Photo: The British Museum



Fig. 7: Albrecht Dürer, Self-portrait drawing age 13, 1484, The Albertina Museum Vienna. Photo: Scala Florence



Fig. 8: Jacopo Carucci da Pontormo, Self-portrait, 1525 ca, The British Museum London. Photo: The British Museum



Fig. 9: Parmigianino (Girolamo Francesco Maria Mazzola), Self-portrait, 1525 ca, Kunsthistorisches Museum Vienna. Photo: Scala Florence



Fig. 10: Annibale Carracci, Study for the self-portrait on an easel, 1603-1604 ca, Windsor Castle Royal Library, Royal Collection Trust. Photo: Wikimedia Commons & Royal Collection Trust © His Majesty King Charles III

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**ABSTRACT**

Centred on the role of draughtsman's technologies in the theoretical conceptualisation of *disegno*, this article interrogates the methods of mimesis by Renaissance art theorists from Filarete and Brunelleschi to Zuccaro and Annibale Carracci. Beginning with fifteenth-century definitions of pictorial *disegno* in terms of geometrical perspective, it reframes our understanding of the historical development of Renaissance *imitatio* through the technologies of its instrumentation. It argues that the geometer's tools of compass, setsquare, and mirror, were the means by which technical draughtsmen effected accurate perspectival rendering of the spatial dimensions of land and building surveyance into architectural blueprints and topographical drawing. It thus demonstrates the critical place of the mirror as a key instrument of translation between three and two dimensions that informed Renaissance drawing as *disegno*. It analyses the larger significance of Renaissance *disegno*'s specular conceit in drawing and painting, theory and practice, which extended from the geometry of perspective to the rise of self-portraiture. Through a wide range of sources including treatises, notebooks, prints, paintings and drawings, it charts the development of artistic theories of *disegno* from Alberti to Leonardo, conceptualised as a mirror reflection of the visible field. It thus rewrites our long-held understanding of *disegno* as an Albertian 'window' by demonstrating its conceptual and practice-based foundation in the 'mirror' view of a specular mimesis that would constitute art's fundamental paradigm until early twentieth-century Abstract art.

Incentrato sul ruolo delle tecniche disegnative nella concettualizzazione teorica del *disegno*, questo articolo indaga i metodi di *mimesis* elaborati dai teorici dell'arte rinascimentali, da Filarete e Brunelleschi fino a Zuccaro e Annibale Carracci. A partire dalle definizioni quattrocentesche di *disegno* pittorico in termini di prospettiva geometrica, esso reimposta la nostra comprensione dello sviluppo storico della *imitatio* rinascimentale considerando le tecniche della sua strumentazione. L'articolo sostiene che gli strumenti del geometra, come il compasso, la squadra e lo specchio, erano i mezzi con i quali i disegnatori tecnici realizzavano un'accurata resa prospettica delle dimensioni spaziali di rilievi di territori ed edifici in progetti architettonici e disegno topografico. Esso dimostra pertanto il ruolo chiave dello specchio come strumento di trasposizione dalle tre alle due dimensioni, che caratterizzò il disegno rinascimentale in quanto *disegno*. Esso analizza il più ampio significato del concetto speculare del *disegno* rinascimentale in dipinti e disegni, nella teoria e nella pratica, concetto che si estende dalla prospettiva geometrica alla nascita dell'autoritratto. Attraverso una vasta serie di fonti, che includono trattati, taccuini, incisioni, dipinti e disegni, l'articolo traccia lo sviluppo delle teorie artistiche del *disegno* da Alberti a Leonardo, concepito come riflesso speculare del campo visibile. Riscrive così la nostra tradizionale concezione del disegno, inteso come 'finestra' albertiana, dimostrando che il suo fondamento, sia concettuale sia pratico, rispecchia la mimesi speculare che costituirà il paradigma fondamentale dell'arte fino all'Astrattismo del primo Novecento.