L'IDOMENEO
Idomeneo (2019), n. 28, 41-56
ISSN 2038-0313
DOI 10.1285/i20380313v28p41
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Leonardo's Treatise on Painting

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Abstract. *This article examines some of Leonardo's activities in the final decade of the Quattrocento, a key period for the development of his theoretical considerations of painting and for the rapid development of his artistic practice involving collaborators under his direction. It asks how knowledge was generated in and circulated through Leonardo's workshop by comparing autograph manuscript evidence from this period to the London Virgin of the Rocks. A direct relationship between the visual and textual evidence is further supported by the new physical information about the underdrawing and superimposed paint layers. With an explanatory text at hand, assistants could be taught the highly complex principles governing the reflected play of light and shadow as Leonardo describes in his notes. Without such guidance, the subtleties would be difficult if not impossible to achieve based on direct observation alone. It proposes concrete connections between Leonardo's notes, collaboration in his workshop, and Leonardo's treatise on painting published in abridged form in 1651 which served as a foundational text for the academic instruction of painters throughout Europe and beyond.*

Riassunto. *Il presente contributo esamina alcune delle attività di Leonardo nell'ultimo decennio del Quattrocento, un periodo cruciale per lo sviluppo delle sue considerazioni teoriche sulla pittura e per la rapida evoluzione della sua pratica pittorica, che include la presenza di collaboratori attivi sotto la sua direzione. Ci si chiede come la conoscenza ebbe inizio e circolò all'interno della bottega, attraverso il confronto tra gli scritti autografi dei manoscritti di questo periodo e la* Vergine delle Rocce *di Londra. Un diretto rapporto tra i dati visuali e quelli testuali è ulteriormente rafforzato dai nuovi dati materiali sul disegno sottostante e sulle sovrapposizioni di strati di pittura. Con un testo esplicativo a disposizione, gli assistenti potevano venire istruiti sui principi, di estrema complessità, che governano i giochi di luce e ombra riflessi, quali Leonardo descrive nelle sue note. Senza tale guida, sarebbe risultato difficile, se non impossibile, raggiungere simili sottigliezze basandosi soltanto sull'osservazione diretta. Si propongono qui specifiche connessioni tra le note di Leonardo, il lavoro comune all'interno della sua bottega e il Trattato della Pittura nella forma abbreviata pubblicata nel 1651, che servì come testo fondamentale per la formazione accademica dei pittori in tutta Europa e oltre.*

Recent advances in noninvasive imaging technology, combined with scientific analysis of the physical materials, have led to many revelations concerning Leonardo's experimental techniques and working process. An extraordinary conference held at the National Gallery, London, in January 2012, organized by CHARISMA (Cultural Heritage Advanced Research Infrastructures: Synergy for a Multidisciplinary Approach to Conservation/Restoration), involving eleven countries

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Nota: nel 2018 ha stampato presso l'editore Brill, con la collaborazione di esperti internazionali, *The Fabrication of Leonardo da Vinci's Trattato della pittura with a scholarly edition of the Italian editio princeps (1651) and an annotated English translation* (2 vols.).

and twenty-two institutions, provided the first composite, detailed account of what joint research has achieved[1].

What are the implications of the new technical evidence? This chapter examines some of Leonardo's activities in the final decade of the Quattrocento, a key period for the development of his theoretical considerations of painting and for the rapid development of his artistic practice involving collaborators under his direction. Leonardo's earliest salaried employment by Duke Ludovico Sforza in 1489/9 dates from the beginning of this period, indicating among other things that Leonardo was gaining greater access to the intellectual life at court[2]. Leonardo's first documented apprentices also date from the beginning of the 1490S, when his research on painting, optics, anatomy, the mechanics of weights, and other subjects intensified, soon to be followed by his expanded study of Euclidean geometry and proportion theory, and near the moment of his first ideas for *The Last Supper* (ca. 1492/3).

Circa 1490 also signals the commencement of the second version of the *Virgin of the Rocks.* Although this dating remains somewhat controversial because the documents are difficult to reconcile, by 1490 Leonardo and his associates had been paid nearly in full for the work stipulated in the original contract of 1483[3]. The existence of the second painting is first recorded in a document of April 1506, which states that it was judged incomplete and had to be completed within two

** The following study is part of a systematic comparison of the notes on painting and perspective in MS A with his *Trattato della pittura,* ed. R. Dufresne (Paris, Langlois, 1651), that I published a modem scholarly edition of the text, *Leonardo da Vinci's* Trattato, C. Farago, C. Vecce, and J. Bell, with additional contributions (E.J. Brill, 2018). This article was originally published as "A Short Note on Artisanal Epistemology in Leonardo's Treatise on Painting," in *Illuminating Leonardo*, ed. C. Moffatt and S. Taglialagamba (Leiden: Brill Press, 2016), 51 – 68. All references to the London exhibition are to the catalogue: Luke Syson with Larry Keith and additional contributors, *Leonardo da Vinci: Painter at the Court of Milan* (London: National Gallery, 2011). See also Juliana Barone, "Review of Exhibitions", *Renaissance Studies* 27, no. 5 (2013): 738-753.

[1] "Leonardo da Vinci's Technical Practice: Paintings, Drawings and Influence", National Gallery, London, January 13--14. 2012, CHARISMA conference organized jointly with Centre de Recherche et de Restauration des Musées de France and the British Museum. Now published as *Leonardo da Vinci's Technical Practice: Paintings, Drawings, and Influence/La Pratique technique de Léonard de Vinci*, ed. Michel Menu (Paris, Hermann, 2014).

[2] Jill Pederson, "Henrico Boscano's *Isola beata:* New Evidence for the Achademia Leonardi Vinci in Renaissance Milan", *Renaissance Studies* 22 (2008): 450-475, provides important new textual evidence for Leonardo's circle at the Sforza court. See also Luke Syson, "The Rewards of Service: Leonardo da Vinci and the Duke of Milan", in Syson with Keith, *Leonardo da Vinci*, 12-53.

[3] Document dated 28 December 1484 states they had received 730 of the 800 lire agreed, suggesting the work was nearly done; cited in Syson with Keith, *Leonardo da Vinci,* 171, arguing that the following year they were petitioning for a higher bonus, claiming that a buyer was willing to pay four times the amount currently on offer, justifying the hypothesis that a buyer was indeed found for the first version. Charles Hope, Review of the exhibition, *New York Review of Books*,*29* February 2012, redates the nearly illegible date of the 1484 document to "one year before or after 1489", à dating accepted by Syson (oral communication, Leonardo Colloquium, National Gallery, 26 January 2012).

years[4]. In August 1508 Ambrogio de Predis and Leonardo received final payment for the project, even though we can see today that this second version, now in London, is unevenly finished and incomplete in some areas[5]. The most likely scenario, based on stylistic analysis and the commission documents, is that the London panel was begun around 1491-92[6].

Despite the unevenness of its finish, the quality of the paint handling and coherence of the composition prior to cleaning had been underestimated. Luke Syson and his team at the National Gallery, London, who performed extensive scientific analyses in connection with the conservation treatment of the painting, argue that the cleaned painting has to be a largely autograph work for several reasons, above all because no one else possessed the requisite skills[7]. Perhaps, Syson and National Gallery conservator Larry Keith suggest, it is less important to argue over exactly which hands might have contributed to the surface of the London painting than to contemplate how Leonardo used assistants. With this question in mind, the following discussion asks how knowledge was generated in and circulated through Leonardo's workshop by comparing autograph manuscript evidence from this period to the London *Virgin of the Rocks.* It proposes concrete connections between Leonardo's notes, collaboration in his workshop, and the treatise on painting that Francesco Melzi (ca. 1491- ca. 1570) compiled, which was published in abridged form in 1651 and eventually became the foundational text for the academic instruction of painters throughout Europe and beyond[8].

The chief surviving autograph sources of Leonardo's practical workshop advice to students are notes preserved in Ms A, firmly assigned to the years 1490-92[9]. Ms A records *in nuce* most Of the subjects that Leonardo explored throughout the

[4] There is nearly a complete scholarly consensus that for stylistic reasons the reference could not have been to the first version.

[5] Most notably the angel's left hand supporting the Christ Child, the blue sky in the background, and the light brown wash applied over painted areas of the Baptist's foot and discovered during the conservation treatment. Syson with Keith, *Leonardo da Vinci*.

[6] Research since 2005 shows that the production was more convoluted than its surface appearance suggests. Leonardo began with a different composition; see Luke Syson and Rachel Billinge, "Leonardo da Vinci's Use of Underdrawing in the *Virgin* o/f/ie *Rocks* in the National Gallery and *Saint Jerome* in the Vatican", *Burlington Magazine* 117/1228 (2005): 450-462; and for the proposed dating, Syson with Keith, *Leonardo da Vinci*, 36, 170-172.

[7] Syson with Keith, *Leonardo da Vinci*, 36, 170-172. Syson and his team posit three phases of execution: the main phase in the early 1490S; the mid-to-1ate 1490s; and a third, perfunctory phase after Leonardo's return to Milan in 1506, when a few touches were added to justify the final payment.

[8] Even before it was published in abridged form as Leonardo's *Trattato della pittura* (Paris, Langlois, 1651). manuscript copies circulated in Milan, Florence, Rome, Urbino, and elsewhere, see *Re-Reading Leonardo: The Treatise on Painting across Europe 1550 to 1900*, ed. C. Farago (Aldershot: Ashgate Press, 2009); *Leonardo in Russia: Temi e figure tra XIX e XX secolo*, ed. Romano Nanni, Nadia Podzemskaia (Milan, Bruno Mondadori, 2012).

[9] Primarily on the basis of a memorandum dated 10 July 1492, on the verso of the final sheet, and on the basis of its close connections with other notes such as those in es C, a manuscript that Leonardo described as a treatise on optics begun on 23 April 1490, on f. 15 v.

following three decades of his literary activity. Extensive excerpts from MS A form the spine of Melzi's "Libro di pittura" (Codex Urbinas Vaticanus 1270) and constitute its single largest source.

Theory and practice are profoundly interrelated in Leonardo's notes. If one were to ask how knowledge percolated through his workshop, the answer would have to be that, beyond manual skills and technical procedures, texts might also have been used collaboratively in that setting[10]. Leonardo's treatise on painting itself became such a text, and if Melzi's original project for an octavo-size publication had succeeded, as Carlo Vecce argues he intended based on overwhelming evidence internal to the manuscript, it would have been as convenient a compendium of knowledge as the smaller notebooks that Leonardo himself frequently carried on his person to jot down and refer to ideas and other data[11].

Theory in the Workshop

It has long been recognized that some of Leonardo's notes on painting in the quarto-sized notebook known today as Ms A are closely related to Alberti's *Della pittura*, a copy of which Leonardo must have consulted directly when he wrote the passages that paraphrase Alberti's text, such as the following on f. 109 v, later incorporated by Melzi into Leonardo's *Libro di pittura,* and retained in the abridged printed version of 1651:

> On the grace of limbs
>
> The limbs of the body should be gracefully accommodated to the overall effect you want the figure to produce. If you want your figure to display loveliness itself, you should make the parts delicate and relaxed, without defining the muscles too much, and with regard to those few that you do show, make them sweet, that is, understated, without dark shadows. Make the limbs, especially the arms, disentangled in such a way that no limb forms a straight line with the parts adjacent to it. If the axis of the hips of a person happens to be posed so that the right side is higher than the left, make the joint of the higher shoulder fall along a line perpendicular to it, over the greatest prominence of the hip[12].

[10] For evidence that intellectual work was associated with the studiolo in close proximity to the physical work undertaken in the workshop, see Michael Cole, Mary Pardo, "Origins of the Studio", in *Inventions of the Studio: Renaissance to Romanticism* (Chapel Hill and London, University of North Carolina Press, 2005), 1-35.

[11] Carlo Vecce, "Nota al testo", *Leonardo da Vinci: Libro di pittura*, ed. Carlo Pedretti, transcribed by Carlo Vecce, 2 vols. (Florence, Giunti, 1995, 83-123).

[12] *Libro di pittura* (LDP) f. 114 r, no. 319 MS A, f. 1O9 V (f. 29 V). LDP no. 319 = Trattato, 1651. Chapter ccx.

The corresponding passate in Alberti comes from Book 2, chapters 43 and 44. Even a short excerpt can begin to show both the resemblance in theme and the enormous differences in tone and detail. Near the beginning of chapter 43. Alberti writes:

> We painters, however, who wish to represent emotions through the movements of limbs, may leave other arguments aside and speak only of the movement that occurs when there is a change of position.

Alberti then outlines a taxonomy of seven different movements corresponding to different states of mind that he would like to see in every painting. His advice, famously the first couched in terms of the science of weights, is to recognize the axis of the body and observe the natural limits of movement, both of which underlie Leonardo's discussion in Ms A and set forth the terms in which he was to describe the human figure in many chapters included in the treatise on painting[13].

In between such prescriptions for figurative decorum modeled after Alberti's concerns, Leonardo recorded observations on light and shadow along with practical advice to the painter in the final twenty-five folios of MS A. These passages, and the diagrams that elaborate the distribution of light and dark on solid bodies (the *corpi ombrosi* reduced to circles, the path traveled by light represented as straight lines) suggest that, as he read Alberti, Leonardo had specific problems of representation in mind. Or rather, one informed the other. We are accustomed to considering Leonardo's advice to painters in general terms, but perhaps these descriptions had their origin in his actual workshop during the period that he recorded the advice. There is certainly no reason *not* to think that Leonardo recorded these observations for the use of his students as well as himself. These were the exact years he was first training young apprentices as well as working with independent artists on terms perhaps similar to the terms of Leonardo's association with Verrocchio during the later years of his presence in that shop[14].

[13] On which see, Juliana Barone, "Poussin as Engineer of the Human Figure: The Illustrations for Leonardo's Trattato", in *Re-Reading Leonardo*, 197-236.

[14] On his collaborations with Verrocchio, see David Alan Brown, *Leonardo da Vinci: Origins of a Genius* (New Haven and London: Yale University Press, •998). Syson with Keith, *Leonardo da Vinci*, and *Leonardo da Vinci: Pupil, Painter, and Master, National Gallery Technical Bulletin 32* (London: National Gallery Company, 2011), especially, Marika Spring et al., "Painting Practice in Milan in the 1490s: The Influence of Leonardo", 78-112.

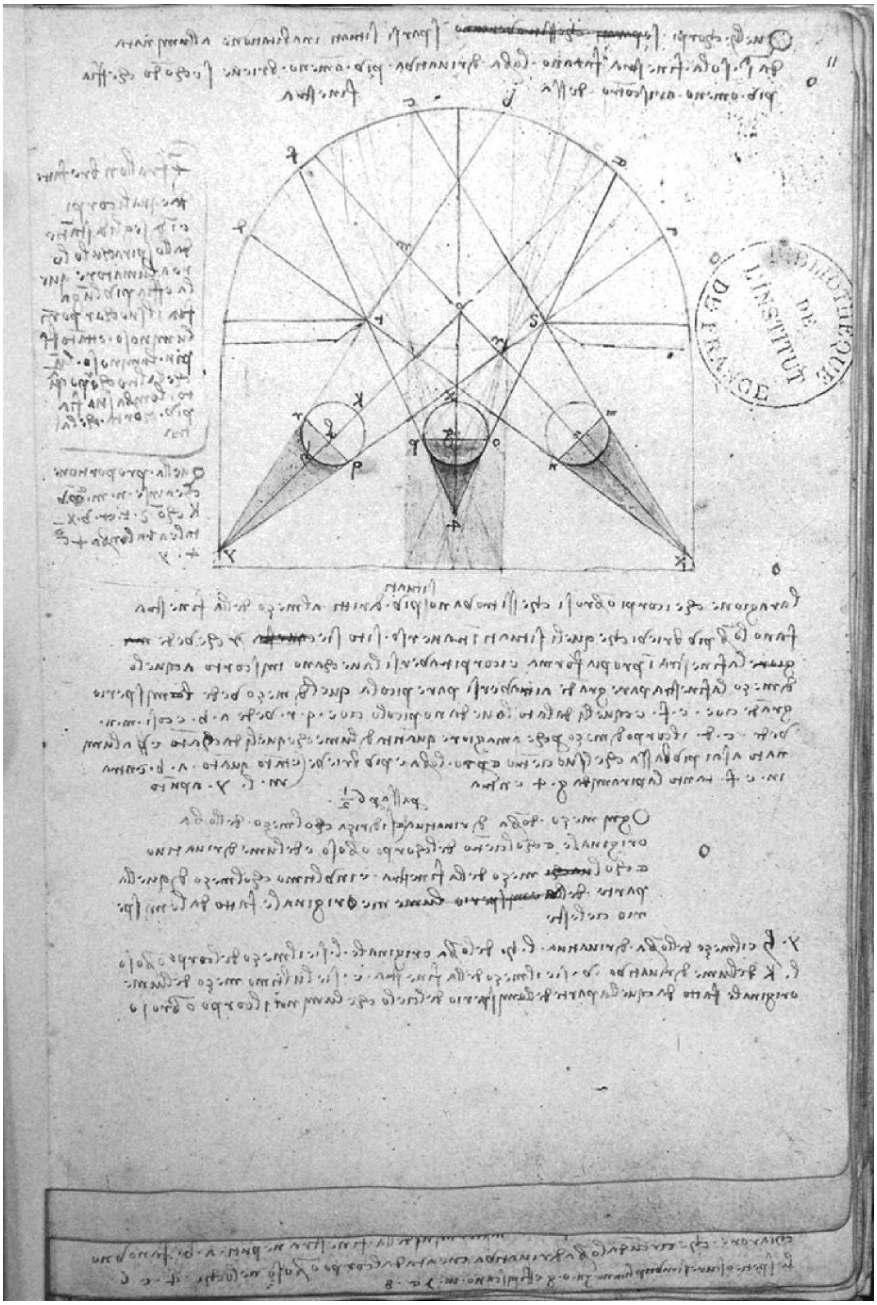

Figure 1. Leonardo da Vinci, *Page of notes and diagrams headed, "Three bodies positioned in a room Illuminated by a single window"*. Paris, Institut de France, Manuscript A, f. 91 r**.**

There is just a hint of his concern with volume depicted through shading in the passage just cited on the grace of limbs, but other passages are devoted entirely to ways of lighting the *corpo ombroso,* a term Leonardo derived from treatises on optics that means "bodies capable of receiving shadow"[15]. On f. 91 r, accompanied by a diagram (Fig. 1), Leonardo develops an extensive set of considerations regarding the different ways in which bodies receive light and shadow if they are seen through a window in a dark dwelling and arranged at different positions equidistant from a single external light source:

> The reason that shaded bodies situated more directly in the middle of the window make shorter shadows than those situated in transverse positions, if they are seen through the window in their proper [i.e., unforeshortened] form, and the transverse bodies are seen in foreshortening. The one in the middle of the window appears large, and the transverse one appears small; that one in the middle appears as a large hemisphere, and those at the side appear small ... the body in the middle, because it has a greater quantity of light than those on the side, if it is illuminated from a point lower than its center, is why the shadow is shorter…[16].

In the rest of this passage and in numerous others, Leonardo explores the multiple reverberations of reflected lights and shadows on *corpi ombrosi* further- and records how bodies fill the surrounding medium with their "infinite similitudes," which carry with them "the quality of body, color, and shape, from their source" (for example, Fig. 2)[17]. Two passages apart from the one just cited on f. 91 r, a paragraph headed "painting" states that:

> The size *[grandezza]* of a painted figure ought to show you at what distance it is seen. If you see a life-sized figure, you know that it is shown as being near the eye.

Gradations of shadow on bodies are examined on the adjacent page, f. 93 v, and on the next page, f. 94 r, a general rule is given at the top of the page, followed by a detailed description accompanying a diagram:

[15] On the terminology, see David C. Lindberg, *Theories of Vision from Al-Kindi to Kepler* (Chicago and London: University of Chicago Press), 1976

[16] LDP f. 211 v-212 v, nos. 726-727 = MS A, f. 91 r (f. ii r).

[17] The passage was not included in LDP. The adjacent diagram, with text noting that when the light enters through a tight opening (*spiracolo*), it inverts the images projected on the dark wall, distinguishes the bodies from which the images are generated by color (red, white, and yellow).

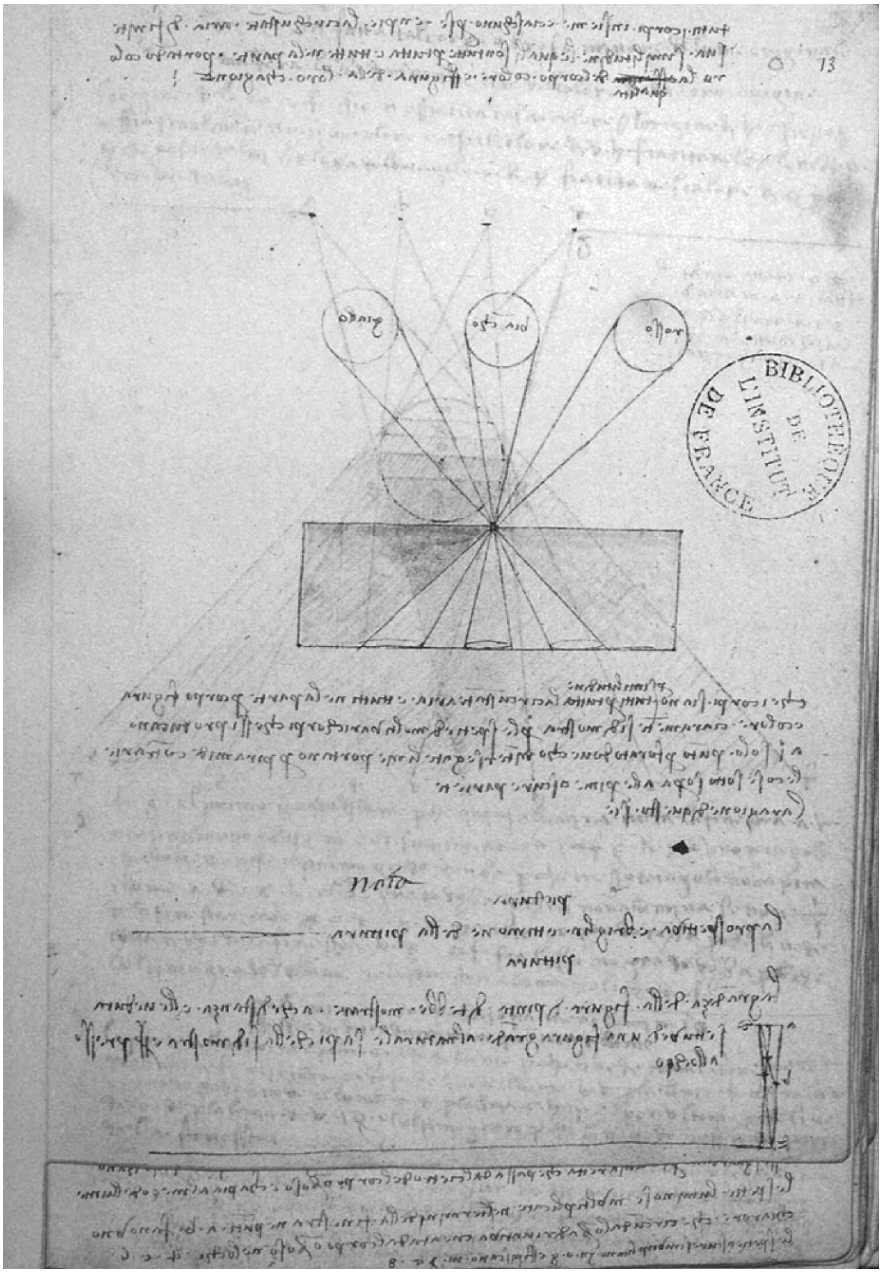

Figure 2. Leonardo da Vinci, *Page of notes and diagrams headed, "All bodies together and individually fil1 the surrounding air with infinite similitudes"*. Paris, Institut de France, Manuscript A, f 93 r.

Every light that falls over *corpi ombrosi* at equal angles takes the first degree of brightness, and that one is darker which receives less equal ang1es[18].

On f. 94 v, Leonardo records two short paragraphs on painting that develop the implications of these lighting conditions. One asks the painter to consider "with the greatest diligence" the boundaries of bodies, the way they twist *(serpeggiare)*, and the way that this twisting is discerned *(giudicato)* if "the faces take on a circular curvature or concave angles". The second paragraph states that shadows that are discerned with difficulty do not have boundaries that can be recognized, so they are understood with "confused judgment". This too should be transferred into the work, because if the painter makes the edges finite or bounded, the work will be "wooden"[19].

Trattato Matters

There are far more passages in Ms A than I can discuss in the present context that demonstrate a clear and direct relationship between the problems of representation encountered through observation of phenomena and those recommended for paintings[20]. What is so striking, however, about the situations Leonardo investigated that are under discussion here is their direct and concrete resemblance to situations depicted in the London *Virgin of the Rocks*, where the figures of the Baptist, the Virgin, the Christ Child, and the Angel are separated from one another and seen as if through an Albertian window emerging from and merging with shadow in the extremities of the picture space, which appears lit from a single central frontal source between the viewer and the framed view. The varied and complex pictorial resolutions to individual instances of the figures' curved and concave surfaces as they emerge from shadow are virtuoso demonstrations of the artist's understanding of the laws governing phenomenal appearances that Leonardo investigated and recorded in Ms A, contemporary with the initiation of the London panel as we see it today.

To point out the most striking resemblances between text and painting, the rendering of the figures suggests how Leonardo's often-stated compositional rule of simultaneous

[18] LDP f. 213 v—214 v, no. 730 = MS A, f. 94 r (f. 14 r).
[19] LDP f. 213 V—214 v, no. 230 = MS A, f. 94 r (f. 14 r).
[20] See further, the forthcoming edition of *Trattato* (n. 1 above).

Figure 3**.** Leonardo da Vinci, *Virgin of the Rocks. Detail of Baptist*, (ca. 1490-1508). London, National Gallery.

Contrast – that is, juxtaposing light against dark on optical principles – governed the choice of representational problems demonstrated in the painting. An excellent example is where the Baptist turns in three-quarter view toward the Virgin. The far edge of his left cheek (Fig. 3) is rendered as a highlighted contour, justified by the action of light as it reflects off the satin-sheened gold-colored lining of the Virgin's robe. A soft, not sharply defined ridge of highlighting extends vertically as the gold lining curves around her body and gradually becomes lost in the shadow. The play of reverberating light in the broken creases of the gold lining is differentiated from the sharper modeling of light and shadow on the drapery folds of the same gold

lining that is facing forward to receive light from a source in the viewer's space directly in front of the painting.

A second area with a very complex play of light/dark juxtapositions occurs where the Christ Child's right arm, raised in a gesture of blessing, recedes behind Christ's neck and head (Fig. 4). The curving planes overlapping in recession create a pattern of oppositions:

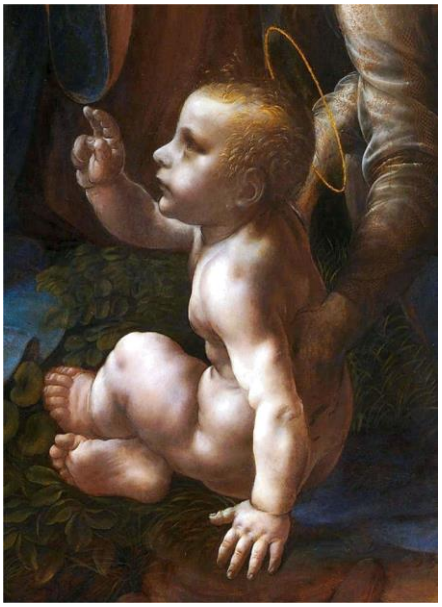

Figure 4. Leonardo da Vinci, *Virgin of the Rocks*. Detail of Christ Child, (ca. 1490-1508). London, National Gallery.

Figure 5. Leonardo da Vinci, *Virgin of the Rocks. Detail of Christ Child*, (ca. 1483-1489g). Paris, Musée du Louvre.

dark neck and underside of chin in shadow, juxtaposed to the lit area of the foreshortened shoulder and upper arm. Within that juxtaposition, the rounded curve of the chin is highlighted and behind the figure a dark, indeterminate shadow provides contrast. The same subtle plays of light and dark, and highlighted curved surfaces, define the Christ Child's upraised gesturing hand. Pictorial clarity is achieved through this series of oppositions.

Yet in the case of the Christ Child, the source of light on the fleshy part of the upper arm is not so effectively justified on optical principles, for what accounts for the highlight in this section of the painting? The optical-that is to say, phenomenal-justification for the presence of light breaks down at this scale of detail. The pictorial solutions to problems of representation generally follow patterns established in the first version of the painting but the cleaned state of the London panel reveals a new assurance and complexity in the handling of the interplay of solid form with light and shadow. In the first version of the composition, the figures seem to glow and the lighting is more generalized. In that painting, the lighting on the upper part of the Christ Child's raised right arm is justified on optical principles (Fig. 5). by which I mean that the position of the arm is just slightly lower than it is in the London version so that the arm receives lighting from the light source located in front of the picture plane, in the viewer's space. In the second version, because the head is not tilted, the chin obscures the upper arm. AL *the same time a more difficult problem of representation is avoided,* namely that of accounting on optical principles for *both* the *tilting* surface receding along a diagonal *and* the direction of light falling *perpendicularly* from the front, outside the window of the picture. This is precisely the kind of situation Leonardo described in Ms A, the passage already cited from f. 94 V that counsels one to consider "with the greatest diligence" the boundaries of bodies, the way they twist *(serpeggiare),* and this twisting is discerned *(giudicato)* if "the faces take on a circular curvature or concave angles".

The Physical Evidence in the Painting

These two details in the two versions of the painting suggest how the London panel documents a collaborative effort involving the very same problems of representation that Leonardo articulated in his discussion of the *corpo ombroso* in Ms A[21]. The most challenging problems of representation, as Leonardo described in graphic and verbal detail in Ms A, involve the successive reverberations of light

[21] This was already not the case in *The Baptism of Christ*, on which see now Jill Dunkerton, "Leonardo in Verrocchio's Workshop: Re-examining the Technical Evidence", in *National Gallery Technical Bulletin* 32, 4-31 The technical evidence shows that the head of the Angel and the underdrawing and perhaps undermodeling of its draperies are in tempera, by Verrocchio, with Leonardo painting the draperies in oil.

and the gradual merging of curved surface into shadow so that “shadows which are discerned with difficulty do not have boundaries that can be recognized”[22]. This includes the creation of pictorial situations so that “that [body] is darker which receives [light at] less equal angles”. The nearly contemporaneous, slightly earlier, Ms C (149) records Leonardo's quantified analysis of the gradation of light and dark on the *corpo ombroso*, but that manuscript is completely lacking the application of these principles to specific, complex problems of representation. Ms C does not discuss the degrees of shadow on curved solid forms situated in darkness behind a window opening and illuminated by a single light source. Only Ms A investigates this complex problem in representation. There Leonardo's detailed observations are intermingled with Albertian precepts on figurative decorum, elaborate defenses of painting compared with poetry, sculpture, and music; and practical advice to the young artist that was collected and redistributed in the initial parts of the *Libro di pittura*, as discussed further below.

A direct relationship between the visual and textual evidence is further supported by the new physical information about the underdrawing and superimposed paint layers. Conservators Larry Keith and Jill Dunkerton describe how Leonardo achieved infinitely subtle gradations of modeled flesh by extraordinarily simple means[23]. It has long been supposed that Leonardo created subtle *sfumato* transitions in the final blending of light and shade through superimposing many fine, translucent layers. Yet the London *Virgin of the Rocks* does not bear this out: it consists of just two basic layers, opaque leaded paint, comprised largely of white pigment with small amounts of color, laid over the monochromatic understructure of the composition. The dark tones were created in the first tonal underpainting[24]. The same structure is clearly visible in the unfinished *Musician* panel, dated ca. 1486-87 by Syson and Keith, where the edge of shadow cast by the nose is created within the undermodeling, a technique that ultimately derives from Verrocchio’s painting procedure in the late 1460s of shading with washes in the underdrawing[25]. The current generation of technical evidence about Leonardo's other, finished Milanese portraits, as well as portraits by

[22] See n. n. i8.

[23] Larry Keith, “In Pursuit of Perfection: Leonardo’s Painting Technique”, in Syson with Keith, *Leonardo da Vinci*, 54-79. see esp. 6o-6i, 69-70; Dunkerton, “Leonardo in Verrocchio’s Shop”.

[24] Keith, “In Pursuit of Perfection”. First the whole panel was covered with a coating of gesso, on which an initial drawing was brushed on with lamp black, then a thin layer of lead white, which veiled, but did not obscure, the drawing below, which now appeared a cool blue-grey, providing a mid-tone in the flesh modeling. This was followed by new brushed drawing in line and wash in dark browns and blacks, which served as the tonal modeling for the subsequent layers of flesh paint.

[25] The dark tones were created in the first tonal underpainting rather than by glazing over flesh layers. The technique of the Louvre portrait known as In *Belle Ferronnière* is an even more efficient version of the same procedure, dispensing with the gesso base layer. Dunkerton, “Leonardo in Verrocchio’s Shop”, 13-15. suggests that Leonardo’s preference for shading with washes rather than hatching-so that the underdrawing and painting phases cannot be separated-derives from Verrocchio’s painting procedure in the late 1460s, a procedure that may have derived from the Pollaiuolo brothers.

his students such as Giovanni Antonio Boltraffio, should eliminate any lingering doubt that the simple paint structure of the Ruhemann, which removed varnish from this painting[26]. The results are stunningly illusionistic trademarks of Leonardo and the artists most closely associated with him in the 1490s such as Giovanni Antonio Boltraffio, Marco d'Oggiono, Francesco Napoletano, and Ambrogio de Predis.

Given these recent revelations regarding Leonardo's simple procedure for modeling flesh developed during his first Milan period, it might be useful to think of his painting technique in the 1490s as evolving along two trajectories, two parallel modes entailing different technical procedures, a dark style and a bright style. For, as effective as it was, the two-layer technique of modeling had severe limitations: it was astonishingly subtle and powerful for rendering faces and figures emerging from dark backgrounds, but not well-suited to rendering figures in an open-air landscape where the reverberating play of reflected color and light is far more complex because the colors do not recede quickly into shadow. The play of reflected color is another subject discussed in Ms A[27]. Similar concerns with reflected color are demonstrated in *The Last Supper*, beyond the scope of the present discussion, where Leonardo's figure composition corresponds to other passages in the same section of MS A that paraphrase and engage critically with Alberti's advice for composing a multifigured *istoria*[28].

From Workshop to *Trattato*

We know that, in the process of transcribing text and images from MS A to the *Libro di pittura*, Melzi rearranged the order of passages according to thematic subdivisions. Ostensibly, the rearrangement was made for the sake of bringing together passages of various dates on the same subject[29]. Yet the result, as has been widely observed since the mid-seventeenth century, was incoherent to many[30].

[26] See Dunkerton, "Leonardo in Verrocchio's ShO". 41 ff.

[27] See Janis Bell, "Color Perspective, c. 1492", Achademia *Leonardi Vinci 5* (1492): 64-77; idem., "Aristotle as a Source for Leonardo's Theory of Colour Perspective after 1500", *Journal of the Warburg and Courtauld Institutes 56* (1993): 100-118.

[28] See my discussion of Leonardo's reading of Alberti in Claire Farago, *Leonardo da Vinci's 'Paragone'*: A Critical *Interpretation with a new Edition of the Text in the Codex Urbinas* (Leiden, E.J. Brill, 1992), 340-346, and *passim*.

[29] Along the lines of the ion passages incorporated from Libro A, ca 1508-10, as I have discussed elsewhere, "How Leonardo da Vinci's Editors Organized His Treatise on Painting and How Leonardo Would Have Done It Differently", in *The Treatise on Perspective: Published and Unpublished*, ed. Lyle Massey, Studies in the History of Art 59 Center for Advanced Study in the Visual Arts, Symposium Papers 36 (Washington: National Gallery of Art, 2003), 21-52.

[30] See Thomas Frangenberg, "What Paris Saw: Fréart de Chambray on Optics and Perspective", in Imitation, *Representation and Printing in the Italian Renaissance*, ed. Roy Eriksen, Magne Malmanger (Pisa-Rome, 2009), 61-82.

Given the apparently jumbled manner in which Leonardo's statements on painting have come down to us, it has been more realistic for many scholars to chart the range of his ideas on a given topic than to set those ideas into a developmental sequence. In a foundational study that takes this synthetic approach, Mary Pardo argues that Leonardo's procedures for training artists to fabricate paintings, which are known from MS A, are fundamentally similar to those described in Cennini's *Libro dell'arte*[31]. There the painter's training begins with making grisaille drawings from two-dimensional models to learn contour and shading, then copying sculpture in the round, and then developing a personal style by drawing from natural objects.

The passages I have discussed are excellent examples of Leonardo working within and expanding upon this same time-honored procedure for training artists[32]. As Pardo emphasizes, the partnership of memorization and visualization at an individual level is important to the educational system that both preceded Leonardo and followed him. At its core is the objective of training artists to make good choices based on understanding nature's causes from phenomenal evidence[33]. The recursive aspects of the educational process are important to bear in mind. Repetition (*fare e rifare)* is essential to acquiring a combination of motor skill and good judgment at each step of the process. Leonardo and Cennini each describe the painter's progress from the fundamentals of establishing *rilievo* to the more advanced stages of drawing from three-dimensional models and, finally, composing figurative compositions.

The first chapter in the *Parte secunda* of Melzi's original compilation became the opening statement of the abridged *Trattato.* This is the well-known passage excerpted from f. 97 v of ms A, titled "What a Youth Needs to Learn First" *[Quello che deve prima imparare il giovane]*. Originally this advice to young painters was recorded in the midst of the same section of MS A, where the passages dealing with the *corpo ombroso* and Albertian prescriptions for figurative decorum that I have been discussing are located. The transitions from one subsection of the text to another are fluid, but the important point is that the compilation in the *Libro di pittura* treats successively more complex aspects of the artist's training, beginning with a foundation in perspective, then dealing more extensively with training the painter's judgment, then a series of chapters giving more advanced advice on how

[31] Mary Pardo, "Leonardo da Vinci on the Painter's Task: Memory/lmagination/ Figuration", in *Leonardo da Vinci and the Ethics of Style*, ed. Claire Farago (Manchester: Manchester University Press, 2008). 58-95.

[32] Cennini's treatise is far from being simply a technical manual. See Andrea Bolland, "Art and Humanism in Early Renaissance Padua: Cennini, Vergerio, and Petrarch on Imitation". *Renaissance Quarterly* 49 (1996): 469-487; Thea Burns, "Cennino Cennini's *Libro dell'arte*: A Historiographical Review", *Studies in Conservation* 56/1 (2011): 1-13 My thanks to Elisabeth Walmsley for the latter reference.

[33] Pardo, "Leonardo da Vinci on the Painter's Task", discusses passages in MS A where Leonardo advises the painter to exercise his visual memory in various ways for example, Leonardo recommends to the student that he trace the contours of things studied earlier in his *imaginativa* as he lies in bed in the dark.

to portray things in relief, followed by advice on how to compose figures in the *istoria*. To an artist already familiar with the recursive strategies of the workshop, as Melzi himself was of course, the organization of the *Libro di pittura,* and later the *Trattato,* might not have been as difficult to flow as it would be for other, differently educated readers. That is, the repetitions due to the grouping of passages on similar themes could be understood in terms of a longstanding sequence of training through repetition and increasing complexity that links Cennini to Leonardo to Melzi and beyond, structurally and historically[34].

As for the specific passages in Ms A that have been the subject of this note, the passage on f. 94 v and two that follow it on the reverberations of light rays on *corpi ombrosi,* were all excerpted in the *Libro di pittura* (LDP) and retained in the abridged *Trattato,* but they were separated into different subsections (as *Trattato* Chapters Lx, LXXVI, and LII). Two short passages on f. 93 r, on painting, were excerpted into the *Libro di pittura* and retained in the *Trattato* as one combined text (LDP 509/ *Trattato* Chapter cccxlix). The more technical passages about the *corpo ombroso* were excerpted into the fifth book on advanced problems of light and shadow in the *Libro di pittura,* but eliminated from the abridged text, that is, the historical *Trattato della pittura,* the sole form in which Leonardo's writings on painting circulated widely for three centuries, which consisted of books two, three, and four only of the *Libro di pittura*[35].

This disconnect bears directly on our present day understanding of how Leonardo and other artists, who might have followed his teachings or had similar knowledge from other sources, could have employed a team of assistants with different skill levels. While Syson and Keith argue that the London *Virgin of the Rocks* must be autograph because no one else possessed the requisite skills, assistants, with an explanatory text at hand, could be taught the highly complex principles governing the reflected play of light and shadow as Leonardo describes in his notes in MS A. Without such guidance, however, the subtleties would be difficult if not impossible to achieve based on direct observation alone. And, more significantly as far as the abridged text of the *Trattato* is concerned, without diagrams, passages about the subtleties of representing light and shadow like those discussed in this essay can become confusing, as some early readers of the *Trattato* lost no time in observing.

[34] In this connection it is significant that the earliest citation of Cennini's text comes from Vincenzo Borghini, who acquired a manuscript copy in 1564; see Angela Cerasuolo, *La tecnica nella pittura e nella letteratura artistica del Cinquecento* (Florence, Edifir, 2014) Many thanks to the author for sharing her work with me in manuscript.

[35] The diagrams on MS A, f. 91 v-93 r were not transferred at all. Passages discussed in this essay that were transferred include: 90 v-92 r (*corpo ombroso* and a light source) became LDP 725a, 725, 726-727; f. 93 became LDP 728 and 729; f. 94 r became LDP 730; f. 95 (rays striking through openings) became LDP 731; f. 95 v (rays crossing on the *corpo ombroso* seen through a window) became LDP 732 and 734; f. 96 v (shadows on the *corpo ombroso*) became LDP 669. None of these passages copied into Book Five of the *Libro di pittura* were retained in the Trattato.