

WEEK SIX - VIRTUAL MUSEUMS AND GENERATIVE ART

Thursday, 29 February 2024, 12:45 - 2:15 PM EST.

Harvard Art Museums, 600

OUR FIRST INTERACTIONS with the great works of art is usually through reproductions. Leo Steinberg (1920-2011), the American critic who transformed the way art history was written from rigorous formal exposition to approachable first-person narrative, first encountered art as a twelve-year old living with his Russian- émigré family in Berlin in 1923. Upon visiting a Socialist bookshop, he found the only book that wasn't about politics: *Die Früh-Renaissance der italienischen Malerei* (Fig. 109). The boy was enraptured by two hundred gray-and-reproductions of pictures that he could not stop looking at, and he would not stop looking for the rest of his life (Fig.). With this childhood memory, Steinberg disagrees with the "grown-up" view of Walter Benjamin, another Berliner and critic, who argued that distance from original works deprives them of their aura. The twelve-year old Steinberg discovered that the aura of an art work is "born in enchantment and nourished by reverence".¹⁵

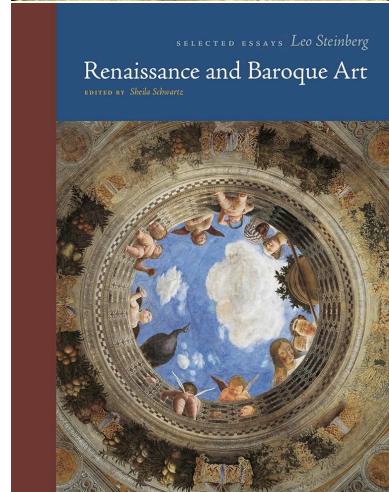
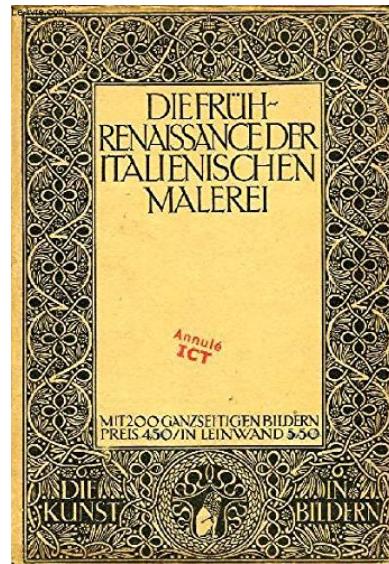
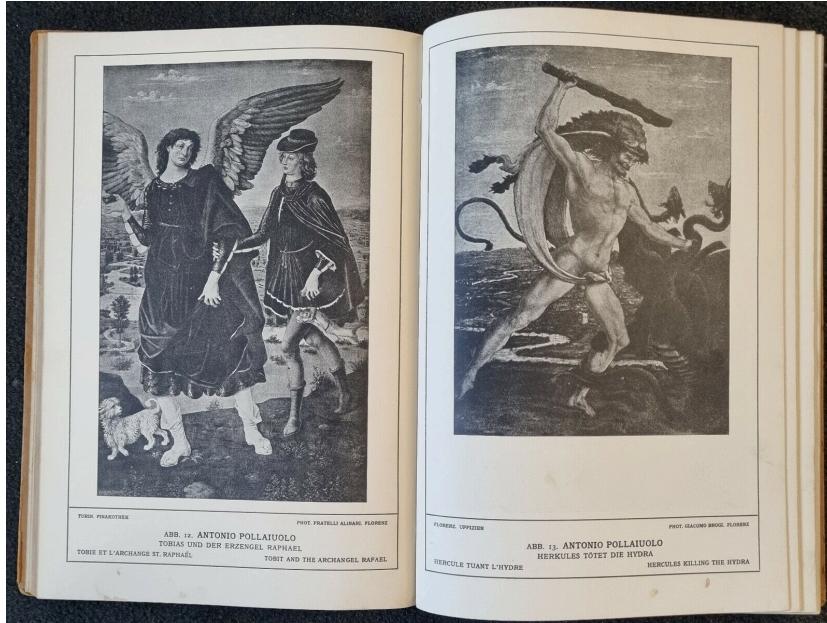


Figure 109: Top: Cover of *Die Früh-Renaissance der italienischen Malerei* that first enraptured Steinberg, pages reproduced in Fig. . Bottom: Cover of Steinberg's own lifelong writing on Renaissance and Baroque Art, depicting a ceiling painting by Mantegna (1431-1506) in the *Camera degli Sposi* of the Ducal Palace in Mantua that creates the illusion of looking upward to a blue sky with angels playing around a balcony, full of visual jokes like the boy angel threatening to drop an apple on the viewer.

¹⁵ Leo Steinberg. *Renaissance and Baroque Art : Selected Essays*. Steinberg, Leo, 1920-2011. Essays. Selections. 2018. The University of Chicago Press, Chicago, 2020

DAVID HOCKNEY HAD HIS FIRST ENCOUNTER WITH RENAISSANCE ART as an eleven-year old in 1948, seeing a poster reproduction of Fra Angelico's *Annunciation*. (Fig. 110). Hockney still thinks about the construction of linear perspective in Fra Angelico's *Annunciation*. In 2017, he responded to Fra Angelico with his own *Annunciation* where the perspective is 'reversed', instead of lines of perspectives converging to a central vanishing point, the lines of perspective expand outward, more like how we experience a wide vista with our visual perceptions (Fig. 111). As an eleven-year old, Hockney had a turning point:

At the age of eleven, I decided, in my mind, that I wanted to be an artist, but the meaning of the word "artist" to me then was very vague – the man who made Christmas cards was an artist, the man who painted posters was an artist, the man who did lettering for posters was an artist. Anyone was an artist who in his job had to pick up a brush and paint something... The idea of an artist just spending his time painting pictures, for himself, didn't really occur to me. Of course, I knew there were paintings you saw in books and in galleries, but I thought they were done in the evenings, when the artist had finished painting the signs or the Christmas cards or whatever they made their living from.



Figure 110: Fra Angelico, *The Annunciation*, 1440-1445, fresco, San Marco, Florence.



Figure 111: David Hockney, *The Annunciation*, 2017, acrylic on canvas, 121.9 cm x 243 cm.

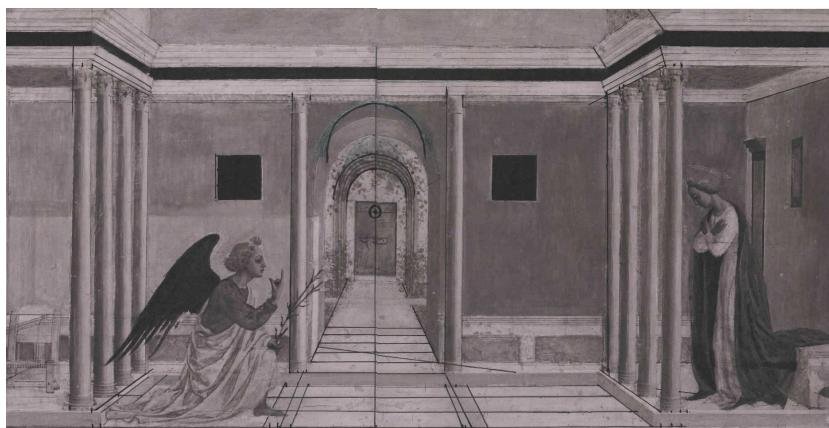
MARTIN KEMP'S FORMATIVE CAREER EXPERIENCE was with a real painting. The future art historian originally went to Cambridge University planning to study the natural science as an undergraduate. After arriving, he visited the Fitzwilliam Museum in Cambridge, where he discovered the *Annunciation* by Domenico Veneziano (1410-1461). This little picture, only 10" by 21", appealed to his scientific leanings with geometry incised into white gesso priming and passages of light that intrigued with religious and thematic meaning. This little picture marked Kemp's transition to art history.¹⁶

¹⁶ Martin Kemp. The annunciation by domenico veneziano. *Country Life*, page 44, 07 2018



Figure 112: Domenico Veneziano, *The Annunciation*, 1440s, Fitzwilliam Museum, [Link to painting](#)

Figure 113: Martin Kemp's analysis of linear perspective in the gesso priming of Veneziano's *Annunciation*.



IN OUR DIGITAL AGE, vast numbers of paintings and entire museums have been photographed, scanned, digitized, cataloged, and made available on the internet. During the pandemic, most art could only be seen as digital images. The Google Arts and Culture Program might be the largest repository of visual cultural heritage, with images of thousands of paintings from hundreds of museums worldwide taken with their traveling gigapixel cameras (although not the Louvre or the Prado). The Mauritshuis in The Hague, Netherlands – home of Vermeer's *The Girl with a Pearl Earring* and *The View of Delft* was an early adopter, fully digitizing seamless panoramic views of every brick-and-mortar gallery with gigapixel resolution, allowing a virtual reality tour through its rooms. This required collaboration between computer scientists and curators to solve an inverse perspective problem, creating the illusion of viewing actual two-dimensional paintings while virtually exploring a three-dimensional space.

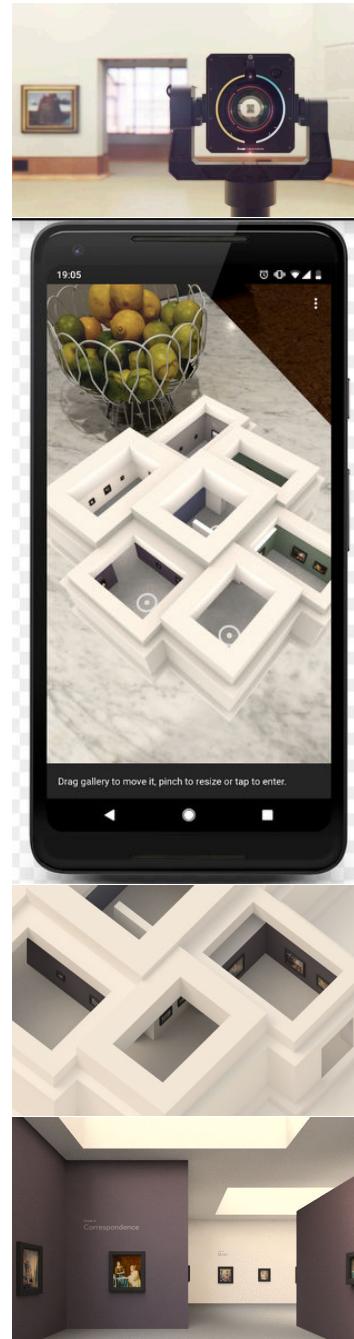


Figure 114: Top: Google's Art Camera captures gigapixel images of paintings, which can be used to build galleries with virtual reality in their "pocket gallery". artsandculture.google.com

Figure 115: *The Girl with a Pearl Earring*. In the Mauritshuis Museum, Netherlands. [Link to painting at Mauritshuis](#)

DIGITAL IMAGING AND ANALYSIS can reveal more than you can see with naked eye. Abbie Vandivere at the Mauritshuis led the most recent technical analysis of *The Girl with a Pearl Earring* with non-invasive imaging tools with non-visible wavelengths.¹⁷ This work revealed new clues. Vermeer used underlayers that varied in tone. He let these underlayers dry before applying surface paint, using thinner or thicker upper layers in different regions of the painting, thereby controlling how underlayers contribute to the appearance of light and shadow. High-resolution imaging reveals other preparatory steps such as fine black outlines. Analysis has also revealed *pentimenti*, subtle corrections and changes to the painting including relocations of the iris and ear. *The Girl With a Pearl Earring* was carefully planned and perfected at many levels.

DIGITAL IMAGING CANNOT provide the full experience of looking at a real painting that is more than a two-dimensional image. The pearl in *The Girl with a Pearl Earring* is not painted with flat pixels. The pearl in his most famous portrait is only made with a few brushstrokes, one stroke to create a reflection under another thick dab. The pearl only emerges as a reflectance of incident light from just two gobs of paint. Throughout the painting, Vermeer uses subtle reflectance to create effects. Highlights on the girl's lips and eyes reveal points of light reflecting off wet surfaces. Shadow evoke objects that are not actually drawn. Look closely. The bridge of the girl's nose is not directly defined. You 'see' her nose on the basis of its shadow and surface highlights. Digital images capture the aura of *The Girl with a Pearl Earring*, but to understand what Vermeer actually did with brush and paint, you need to see the real thing.

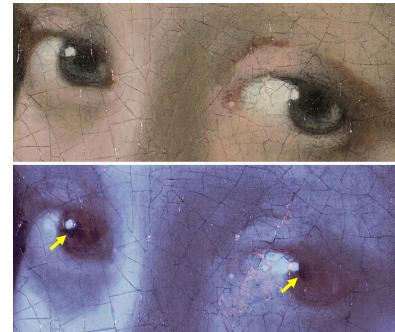


Figure 116: Evidence for pentimenti in the Girl's eyes. a Visible light photograph. b MS-IRR false colour detail. Dark marks indicate possible earlier iris locations (yellow arrows)

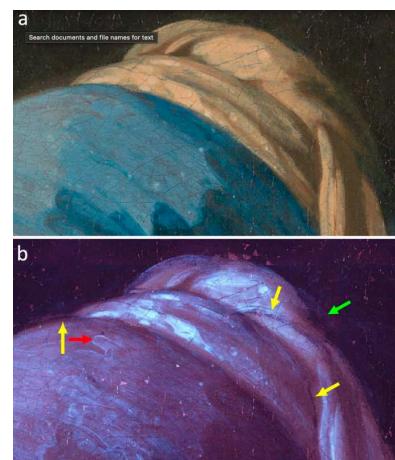


Figure 117: Evidence for contours and fine black outlines in the top of headscarf. a Visible light photograph. b MS-IRR false colour detail. Wavy brushstrokes at the surface (red arrow), fine black outlines applied in a preparatory phase (yellow arrows), back of the headscarf applied on top of an infrared-absorbing layer (green arrow).

¹⁷ Abbie Vandivere, Annelies van Loon, Kathryn A. Dooley, Ralph Haswell, Robert G. Erdmann, Emilien Leonhardt, and John K. Delaney. Revealing the painterly technique beneath the surface of Vermeer's Girl with a Pearl Earring using macro- and microscale imaging. *Heritage Science*, 7:64, 2019

BRICK-AND-MORTAR MUSEUMS are not being replaced by digital galleries, but are seeing resurgent interest. Museums are not only distant sites for celebrity artworks, but are civic monuments, secular temples, and mission-driven enterprises. Museums are integral components of cultural and national infrastructure.¹⁸ In the United States, 35,000 museums account for 750,000 jobs and \$50 billion annually to the economy.

THE ENCYCLOPEDIC MUSEUM is relatively new, an invention of the European Enlightenment, placing values in democratic ideas, public spaces, and intellectual improvement. The British Museum was the first public national museum to cover all fields of knowledge, created by an Act of Parliament in 1753. The Louvre opened in 1793, months after the execution of King Louis XVI. These museums had a head start over the first encyclopedic museums in the United States, the Metropolitan Museum of Art in NYC and the Museum of Fine Arts in Boston, both founded in 1870.

THE BRITISH MUSEUM grew with the depredations of the British Empire. The Louvre grew substantially during the Napoleonic Wars, when a river of artistic and cultural treasures flowed back to Paris. The important turning point that allowed the Metropolitan Museum of Art and the MFA to catch up was a change in American tax law: the War Revenue Act of 1917 permitted income-tax deductions for charitable contributions including artworks. Entire museums were created from estates. In NYC, the Frick Collection was established in 1935 to preserve the art collection of the industrialist Henry Clay Frick. Boston's Gardner Museum was built by Isabella Stewart Gardner (1840–1924) in the style of a 15th-century Venetian palace and has been open to the public since 1903. The Gardner Museum was also the victim of the biggest art heist in history in 1990, when several masterworks including a Vermeer – *The Concert*, now only seen in digital reproduction – were stolen from their gallery. The empty frames of the stolen paintings remain on the walls, awaiting their return.



Boston Thieves Loot a Museum Of Masterpieces

By FOX BUTTERFIELD
Special to The New York Times

BOSTON, March 18 — Dressed as police officers, thieves broke into the Isabella Stewart Gardner Museum here early this morning and made off with 12 priceless artworks, including paintings by Rembrandt, Vermeer, Degas and Manet.

The daring theft, which the museum said was not discovered until the cleaning crew arrived this morning, is believed to be one of the largest in the world, said the Federal Bureau of Investigation and a museum spokesman.

Corey Cronin, a spokesman for the Gardner Museum, said it was very difficult to place an exact value on the stolen paintings because "they were acquired by Mrs. Gardner at the turn of the century" and have never been offered for sale since then. But an official of the Federal Bureau of Investigation in Boston said he heard estimates today that the paintings could be worth anywhere from \$100 million to \$200 million.

Figure 118: Vermeer's *The Concert*, stolen from the Isabella Stewart Gardner Museum. NYTimes, 3/18/1990

¹⁸ Daniel H Weiss. *Why the museum matters. Why X matters*. Yale University Press, New Haven, 2022. ISBN 9780300275209

THOMAS HOVING (1931-2009), the former Director of the Metropolitan Museum of Art, started the tradition of international loans and rotating exhibitions that have become a main part of the programming at most art museums. Most museums now have special exhibition spaces or “white boxes” for blockbuster events and immersive experiences. This innovation started with the loan of the *Mona Lisa* to the Met that drew a million visitors in three weeks. Last year, the Rijksmuseum’s Vermeer exhibition drew 650,000 visitors in 16 weeks.



Figure 119: The courtyard of the Isabella Stewart Gardner Museum.

MUSEUMS ARE NOT REPOSITORIES OR VAULTS, but civic spaces and sanctuaries, works in progress that continuously adapt to stay relevant and serve public good.

DIGITAL ART arrived with digital imaging. David Hockney avoided digital art until recent improvements with the iPad and Apple Pencil. He spent lockdown during the pandemic with the App “Brushes”, depicting the arrival of Spring. With the iPad, Hockney particularly reveled in green. In painting, green is difficult. Pigments that produce pure greens were unstable (natural verdigris and copper resinate), weak (malachite), or poisonous (copper arsenic and copper acetoarsenite, also called ‘emerald’ green). Modern pigments produce varied greens with varied levels of toxicity. With an iPad, Hockney had free reign in experimentation with greens, both viewed on the iPad and the prints he made from the iPad. This requires experimentation. In a natural scene, variations from sunlight to shadow can range over $10,000\times$ in brightness. A digital monitor can produce about 1000 brightness levels. A color printout delivers only about 100 brightness levels. Yet, with controlled color and contrast, the difference between lit lawn and shadow in *20th April 2020 No. 1* renders strong contrast with only $1.2\text{--}1.5\times$ difference in brightness.



No. 219, 20th April 2020, iPad painting, © David Hockney

Figure 120: David Hockney, *20th April 2020 No. 1*, iPad drawing).

COMPUTER-GENERATED ART arrived with better computers. Generative AI can now produce meaningful written content that imitates human language. Artists have been programming computers to deploy ‘rules’ to generating art starting with the earliest programmable desktops. Harold Cohen (1928-2016) was a British-born artist who created AARON, a computer program designed to autonomously produce paintings and drawings. In 1968, he learned to program at UC San Diego and the AI labs at Stanford. In these early days, before color monitors and printers, he programmed mechanical plotters and hand-colored the results. He sought generative rules to guide the pen. The earliest images were abstract. Later, he found rules by which the computer could emulate the growth and structure of leaves and plants, not just their appearance. Cohen eventually discovered rule-based paradigms to generate other shapes and human figures. Eventually, his programs incorporated color. Unfettered by the human visual system, Cohen discovered that the computer created color combinations and contrasts with paint more freely than a human. A retrospective of Harold Cohen’s work is currently at the Whitney Museum of American Art in New York City: [Link to exhibit.](#)



Updated: April 1, 2024



Figure 121: Harold Cohen, *Untitled [Amsterdam Suitel]*, 1977/78. Colored pencil on lithograph.



Figure 122: Active plotters at the Whitney Museum drawing images from different versions of the AARON software.

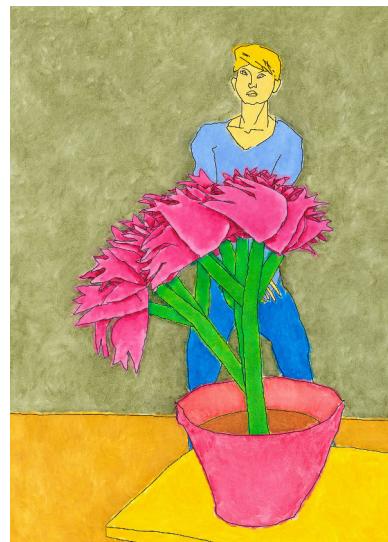


Figure 123: Harold Cohen, *Susan with Plant*, 1991. Acrylic and plotter pen on canvas.

Figure 124: Harold Cohen, *AARON Gijon*, 2007. Screenshot. Artificial intelligence software.

HAROLD COHEN, in his article *Driving the Creative Machine*, makes direct reference to Piero della Francesca in thinking about rule-guided art. *The Flagellation* by della Francesca is a paradigm of linear perspective, where once the artist had defined the stage, the construction of the painting was governed by geometric rules. The notebooks of della Francesca contain numerous calculations and drawings, by which he calculated perspectival projections of complex shapes like the human head with various transformations to include in his paintings.¹⁹ Once the artist defines a seed in his painting, he follows rules to generate the final projections and pictures.

For amusement, I asked whether ChatGPT, the generative chatbot, had anything interesting to say about Piero della Francesca and Harold Cohen. The answer is in Appendix II.

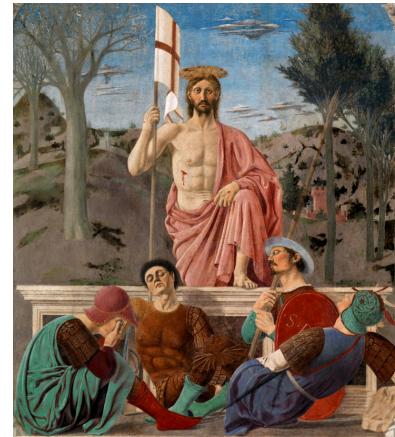
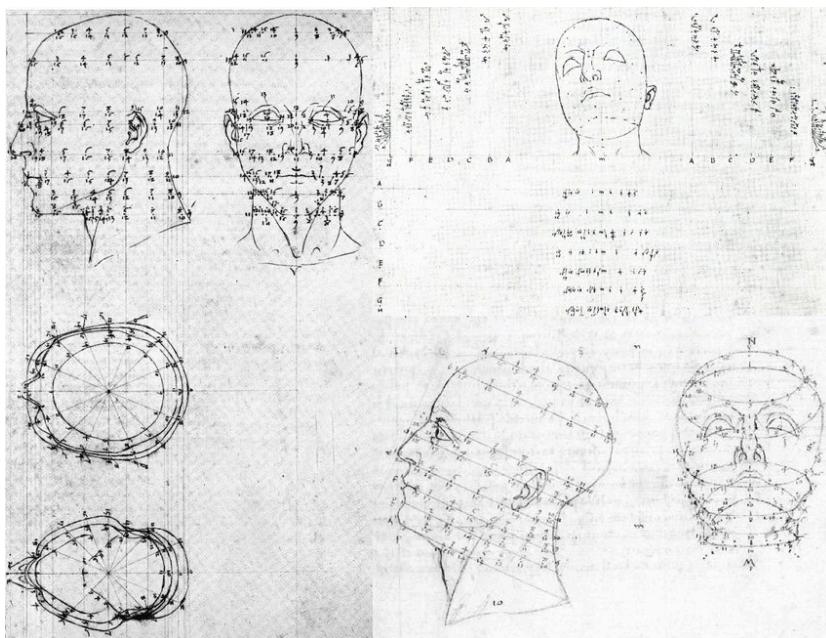


Figure 125: Piero della Francesca, *Resurrection of Christ*, 1465

Figure 126: from Piero della Francesca, *De Prospectiva pingendi*, studies that are incorporated in his *Resurrection of Christ*.

¹⁹ Martin Kemp. *The Science of Art*. Yale University Press, New Haven, Connecticut, 1990. ISBN 0-300-04337-6

I BROUGHT UP LEO STEINBERG at the beginning of this discussion, reminded of his illuminating essay “Mantegna: Did He Paint by the Book?”, where he paints a picture of Andrea Mantegna (1431-1506), a contemporary of Piero della Francesca, similarly enthralled by perspective.²⁰ Steinberg describes the many ways that Mantegna was guided by perspective but not imprisoned by it. The book of the title is Alberti’s *De Pictura* that describes the precepts of perspective, that Mantegna knew but did not slavishly follow.

²⁰ Leo Steinberg, Sheila Schwartz, and Stephen J Campbell. Mantegna: Did He Paint by the Book? In *Renaissance and Baroque Art*, pages 34–69. University of Chicago Press, United States, 2020. ISBN 022666872X



Figure 127: The fictive oculus, or opening to the sky, in the Camera degli Sposi in Mantua by Andrea Mantegna. Created with foreshortening and a strong sense of linear perspective (but looking upward), the oculus is ringed with figures looking down on the room below. A potted plant is perched on a wooden support, seemingly ready to fall. A cherub threatens to drop an apple. The painting is filled with visual jokes, generative figures based on verbalizable concepts, added as ornaments to the ringed balcony. The imaginative act of successively filling the balcony with a set of concept-to-figure illustrations – in the mind and by the hand of Andrea Mantegna – is perhaps not far from attaching text-to-image ornaments to any illustration using generative fill.

READING

- Abbie Vandivere, Annelies van Loon, Kathryn A. Dooley, Ralph Haswell, Robert G. Erdmann, Emilien Leonhardt, and John K. Delaney. Revealing the painterly technique beneath the surface of Vermeer's Girl with a Pearl Earring using macro- and microscale imaging. *Heritage Science*, 7:64, 2019 [Download paper](#)
- Harold Cohen. Driving the Creative Machine Renaissance art. *Orcas Center, Crossroads Lecture Series*, 2010 [Download paper](#)

LOOKING

- Use Google Pocket Galleries to visit a [virtual Vermeer gallery](#).
- Download Adobe Creative Cloud (free with Harvard HUID) and experiment with Adobe Firefly for Generative AI. [Link to Adobe Firefly](#). If you don't mind spending money, you can also try [DALL-E](#) or [Midjourney](#)

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- Leo Steinberg. *Renaissance and Baroque Art : Selected Essays*. Steinberg, Leo, 1920-2011. Essays. Selections. 2018. The University of Chicago Press, Chicago, 2020
- Abbie Vandivere, Annelies van Loon, Kathryn A. Dooley, Ralph Haswell, Robert G. Erdmann, Emilien Leonhardt, and John K. Delaney. Revealing the painterly technique beneath the surface of Vermeer's Girl with a Pearl Earring using macro- and microscale imaging. *Heritage Science*, 7:64, 2019
- David G Stork. *Pixels & paintings : foundations of computer-assisted connoisseurship*. Wiley, Hoboken, New Jersey, 2024. ISBN 9780470229446
- Daniel H Weiss. *Why the museum matters. Why X matters*. Yale University Press, New Haven, 2022. ISBN 9780300275209

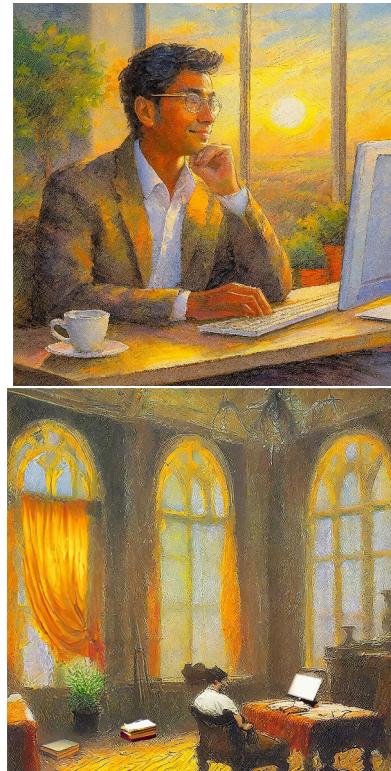


Figure 128: *Self-portraits in office*, Aravi Samuel, 2024, Generative AI

WEEK SEVEN - DRAWING, DÜRER

Thursday, 7 March 2024, 12:45 - 2:15 PM EST.

Field Trip to Ethan Murrow's Studio

59 Wareham Street Boston, MA 02118

We WILL BE GUESTS in the studio of Ethan Murrow, Professor of Painting and Drawing at the School of the Museum of Fine Arts. Ethan's creative practice focuses on historical narratives and the idealized and uncomfortable ways in which they are told, retold, and molded into powerful, absurd, and subjective tales. In addition to works on paper, he develops large scale wall drawings, murals, and installations for site specific projects and exhibitions, working closely with local communities, institutions, and corporations.

We will tour Ethan's studio – *be careful not to touch or bang into his artworks!* He will tell us about his recent work, his methods, and teach us something about drawing. Bring sketchpads!

N.B.: We will meet at Harvard Art Museums 0600 at 12:00 PM on Thursday and Uber back and forth from Ethan's studio, a third floor walk-up or rickety elevator.

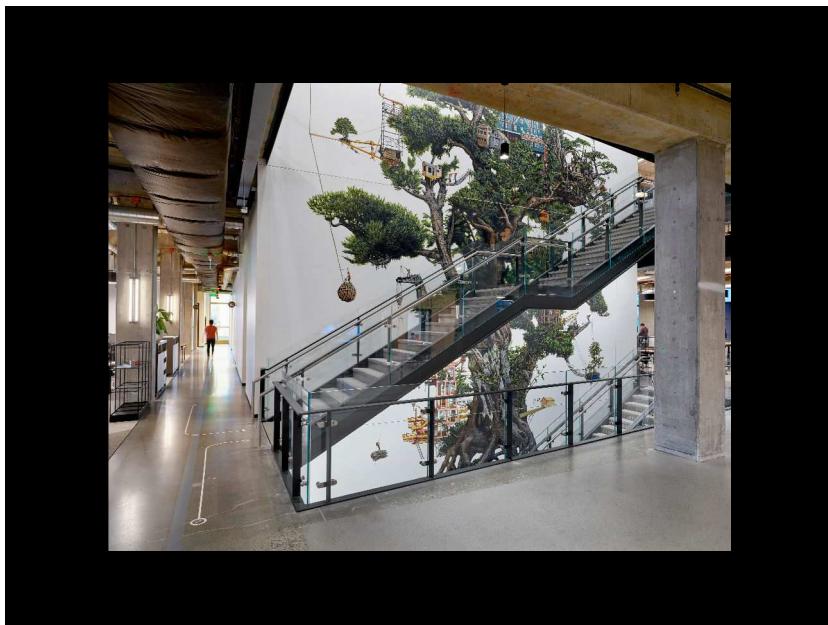


Figure 129: Images from the Expedia Mural Project in 2019 and from "Hauling" commissioned by the Currier Museum in 2018, by Ethan Murrow.



Figure 130: *Seedling Palace* by Ethan Murrow, 2023. Graphite on paper.
48" x 48".



Figure 131: Gideon Bok – drawing what we see not what we know.

Committed to painting the passage of time within a confined space, his own studio, he depicts it over and over in various states of array with objects such as draped clothes, musical instruments, and artist supplies. His intent is to make the room seem alive, showing it shortly after it has been occupied (from the Archives of askArt.)

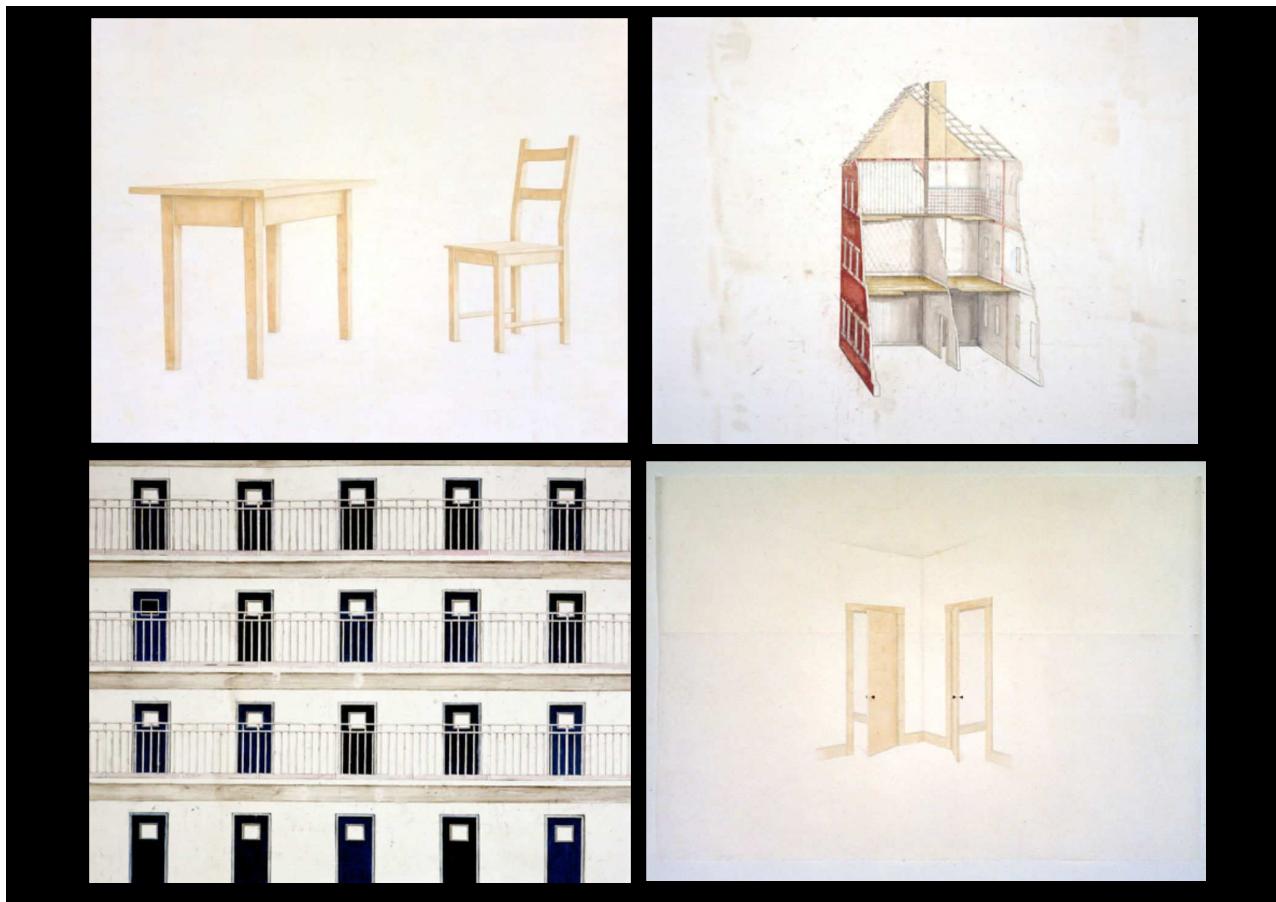


Figure 132: Toba Khedoori – drawing how we think, as icon, symbol, or language. Khedoori frequently depicts architectural forms from distanced perspectives, rendering commonplace objects and spaces familiar yet decontextualized. In recent years, she has transitioned from paper to canvas, producing smaller scale works that hover between representation and abstraction. Like her earlier compositions, these works are enigmatic and acutely detailed; in an art world awash with rapidly moving images and saturated colors, Khedoori remains committed to the silent, slow, and exacting process of working by hand (from www.lacma.org)

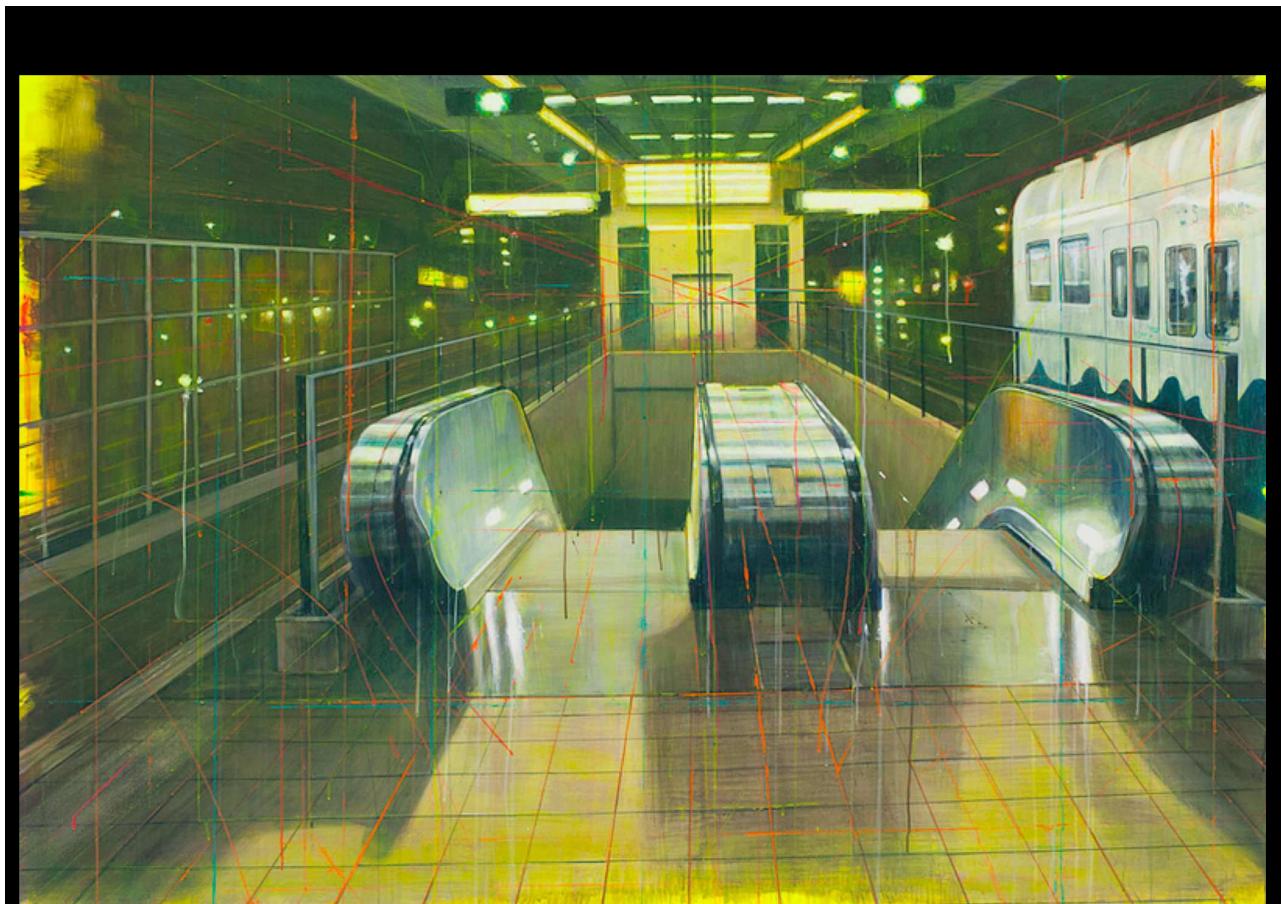
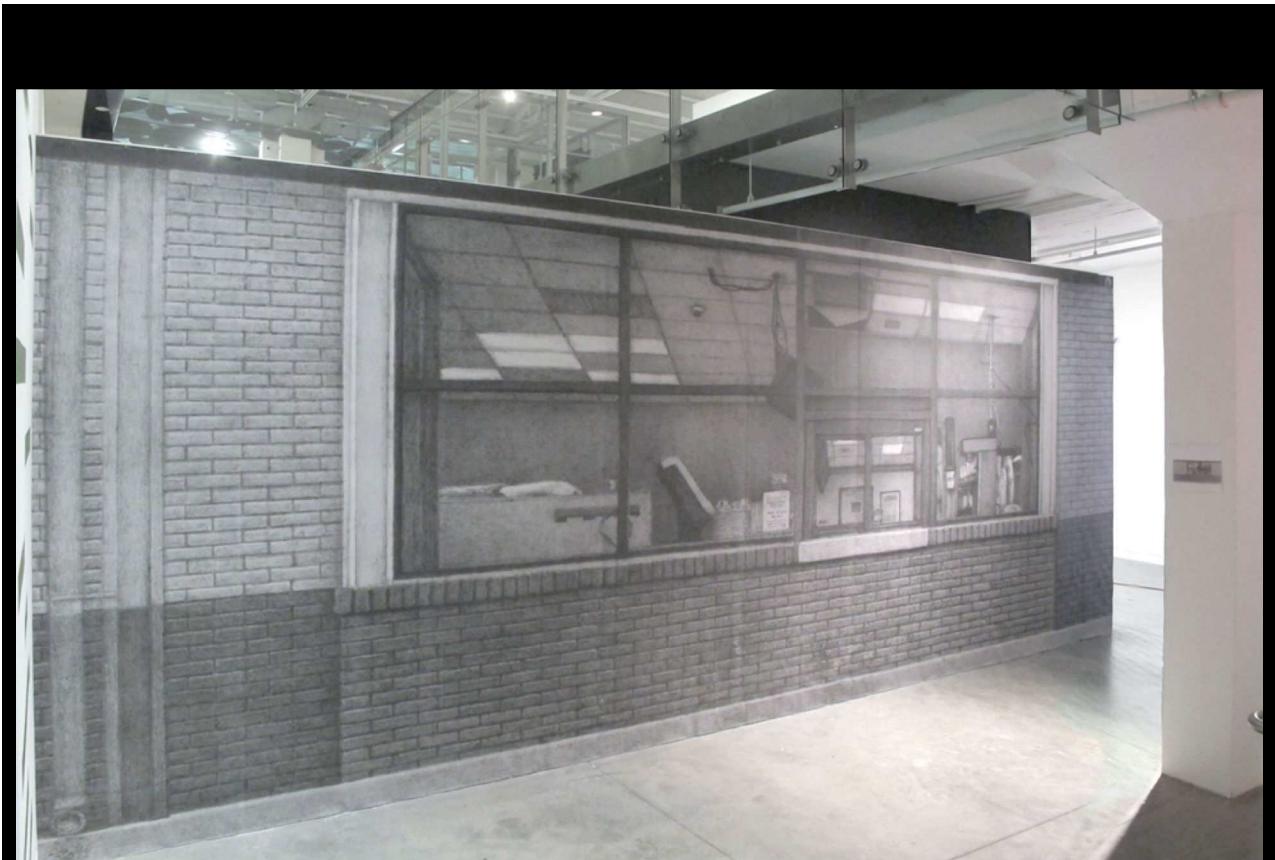


Figure 133: Peter Waite – drawing in relation to what we understand, structure. “For over 25 years I have made large scale paintings that document my travels – real visits to real places – to sites of the built environment that embody public sentiment or ideological concerns. Stadiums, formal gardens, bridges, museums, monuments, palaces, train stations, schools, prisons, casinos, corporate board rooms, suburban and urban housing, and ancient temples, are some of the locations that I have depicted. My interest lies in the intersection of personal and social memory. I have intentionally omitted the figure from the representation to emphasize the viewer’s participation as witness to the moment of perceiving, then remembering, these architectural spaces.” (from www.peterwaite.com)



GARY KATCHADOURIAN / in relation to experience, time, movement

Figure 134: **Gary Katchadourian – drawing in relation to experience, time, movement.** Gary Kachadourian challenges conventional means of art production with his open-source/endless supply approach to drawing. The artist brings fresh eyes to even the most mundane places or objects – a parking lot or a Pepsi machine. He encourages us to view our environment anew. He plays with the role of the artist as creator, as well as reproduction and illusionism in art by copying the world in mass quantities. Kachadourian's process entails sketching and photographing his subject, noting its dimensions, and then creating a detailed drawing. The drawing is scanned and enlarged to the dimensions of the actual object. His to-scale drawings are then reproduced in xerographic prints on paper or on vinyl in infinite supply (from ndi.arkansasartscenter.org)

THE BASICS OF REPRESENTATIONAL DRAWING

1. Draw what you see not what you know.
2. Separate stereotype symbol memory from real time information.
3. Use all of your senses, not just your eyes
 - (a) Common object. Water bottle.
 - (b) Describe out loud what makes it distinctive from other chairs
 - (c) Write words that would help you build this water bottle
 - (d) Now draw the water bottle
 - (e) What do you notice, what was difficult to draw?
 - (f) Review proportion, scale, perspective angles etc.

STARTING PLACES EXERCISE

1. We use our whole body and when able, it is best to stand
2. Remember drawing *and* artwork are subjective, seeing is fluid
3. Try to focus on creating rough summaries, don't get precious
4. Use the side of your drawing tool or a slightly wonky, wobbly approach
5. Focus on gaining a 'sense' of the form, not a perfect rendition
6. Use your eraser to blend / redact
7. Blur your eyes at the object / scene, what does it 'roughly' look like?

MEASURING ANGLES AND PROPORTION.

1. First please find two rectangular items in your space (book, box, etc)
2. Stand it up, put it a feet away from you if possible
3. Get your paper, pencils, straight edges, erasers out
4. Use your hands like a box to look carefully, assess the scene
5. Comparison is key. What is different about the way the objects look?
6. Hold up your straight edge level, what are perceived angles and intersections?



[Video Clip on Perspective Drawing](#)



[Video Clip on Measuring Angles and Proportions in a Still Life](#)



[Ethan's Drawing Process](#)



[Using cross-hatch](#)

7. Next make a quick sketch of what you see
8. Now practice measuring what the angles look like to you
9. Make some adjustments
10. Now practice measuring proportion, compare relative size
11. Make some adjustments
12. What was hard about that? What was confusing?

OTHER EXERCISES TO TEST WHAT YOU SEE AND HOW YOU CAN
RELATE IT TO THE PAGE

1. [Blind Contour Drawing](#)
2. Draw Ethan, no looking at your page
3. [Exquisite corpse drawing game](#)
4. [Go look at Contemporary Art in Boston](#), ICA, MIT List, DeCor-dova, SMFA, Harvard, MFA, etc.

TECHNOLOGY HAS ALWAYS CHANGED ART-MAKING. Beside the discovery of linear perspective, another major 15th century invention was Gutenberg's printing press, first reported in 1439. Books were printed with movable type. Pictures were printed with engraved woodblocks and metal plates. Mass production made paper cheap and plentiful. Paper – processed from old rags into blank, durable, lightweight sheets – changed how artists worked, how ideas evolved, and how rapidly innovation traveled.

WHEN PAPER BECAME PLENTIFUL, it became a way of recording and working out ideas in sketchbooks and notebooks. Among Leonardo da Vinci's new and powerful ideas was simply using paper to develop and plan artwork (Fig. 137).

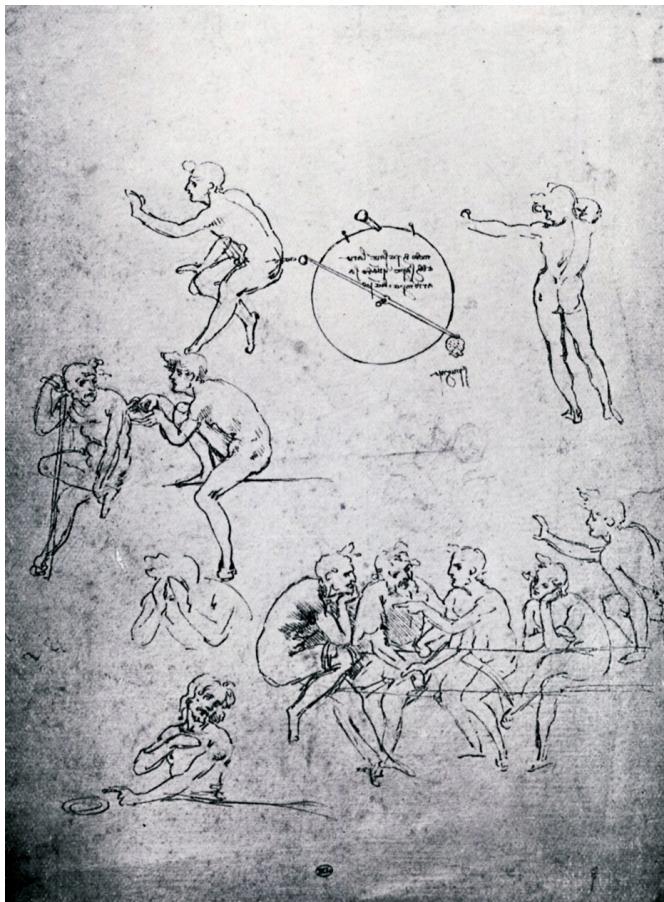


Figure 135: Woodcut showing printer on left removing a page from the press while the printer on right inks a text-block. Two printers could produce 3,600 pages a day.

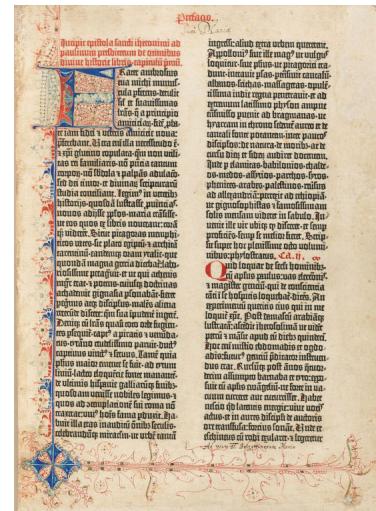


Figure 136: Page from Harvard's copy of the Gutenberg Bible, printed on paper, one of 23 complete surviving copies. It is always on display in the Harry Elkins Widener Memorial Rooms.

Figure 137: Studies for *The Adoration of the Magi* and *The Last Supper*, Leonardo da Vinci

AFTER RULES FOR LINEAR PERSPECTIVE were discovered by Brunelleschi, sometime after 1410 in Florence, their use in artistic depiction spread through Europe. Before Brunelleschi, Northern European had its own version of realism: a heightened attention to detail, minutely observed, exactly reproduced, and densely wrought. In the *Knights of Christ* panels of his Ghent altarpiece, Jan van Eyck seems to render each leaf on each tree, each hair on each horse, each crack on each crag, and each mirroring off each armor-plate (Fig. 138). Before Brunelleschi discovered perspective and before its rules were described by Leon Battista Alberti (1404-1472) in *De Pictura*, published in 1435, van Eyck did not know how to invoke the laws of linear perspective to create two-dimensional projections of three-dimensional scenes. No painting by van Eyck has a central vanishing point. The convergences of parallel lines in van Eyck's painted rooms are intuited. Lines from above point converge downward, lines from below converge upward, but without precise mathematical control. Something changed in Northern Europe from van Eyck to Vermeer, when a more rigorous knowledge of perspective would add a layer of geometric realism to Dutch Golden Age paintings.



Figure 138: Two panels (left) and details (above) from *The Ghent Altarpiece*, the large and complex polyptych altarpiece in St Bavo's Cathedral, Ghent, Belgium. It was begun by Hubert van Eyck in the 1420s and completed in 1432 by Jan van Eyck. The altarpiece has been called the "first major oil painting". [Link to painting](#)



Figure 139: *The Annunciation* by Jan Van Eyck, 1434-1436, depicting Gabriel telling the Virgin Mary that she will bear Christ. The inscription shows the words *AVE GRA PLENA* ('Hail, full of grace...'), she responds, *ECCE ANCILLA D[OMI]NI* ('Behold the handmaiden of the Lord'). The words are upside down because they are directed to God and inscribed with God's-eye view. van Eyck knew about perspective, just not linear perspective. [Link to painting.](#)

THE DIFFUSION OF ITALIAN GEOMETRICAL PERSPECTIVE TO NORTHERN EUROPE was largely due to Albrecht Dürer (1471-1528). Dürer from Nuremberg was a prodigy (Fig. 140) steeped in the Northern European tradition to heightened detail (Fig. 142). But Dürer also appreciated the revolution of the Gutenberg press in the 1430s and, soon thereafter, the invention of the postal service by Emperor Maximilian in Innsbruck in 1450. Dürer shrewdly devoted himself to works on paper: drawing, etching, and woodblock printing. The printing press and the mobility of paper became Dürer's road to fame. His first mega-hit was his *Apocalypse*, printed and seen throughout Europe (Fig. 143). Dürer was one of the first artists to recognize the value of a trademark – his signature 'D' under tabular 'A' – ensuring that credit for each work returned to him, deterring plagiarism, and aiding authentication (Fig. 141).



Figure 140: This *Self-Portrait* is a silverpoint drawing by Albrecht Dürer made in 1484 when he was twelve or thirteen years old. It is the artist's oldest known surviving drawing and one of the oldest self-portraits in European art. [Link to Wikipedia](#).



Figure 141: Dürer's monogram

Figure 142: The *Young Hare* by Dürer, a 1502 watercolor on paper, achieves an almost scientific level of detail, rendering fur in different directions, mottling with light and dark patches, and glints of the eyes. [Link to Wikipedia](#).



Figure 143: The third woodcut from Dürer's *Apocalypse*, depicting a passage from Revelation (6:1–8): "And I saw, and behold, a white horse, and its rider had a bow; and a crown was given to him, and he went out conquering and to conquer. When he opened the second seal, I heard the second living creature say, 'Come!' And out came another horse, bright red; its rider was permitted to take peace from the earth, so that men should slay one another; and he was given a great sword. When he opened the third seal, I heard the third living creature say, 'Come!' And I saw, and behold, a black horse, and its rider had a balance in his hand; ... When he opened the fourth seal, I heard the voice of the fourth living creature say, 'Come!' And I saw, and behold, a pale horse, and its rider's name was Death, and Hades followed him; and they were given great power over a fourth of the earth; to kill with sword and with famine and with pestilence and by wild beasts of the earth." [Link to the Metropolitan Museum of Art](#)

DÜRER WAS NOT ONLY A TALENTED DRAFTSMAN AND SHREWD PRINT-MAKER, but also a gifted mathematician who wanted to learn and disseminate the principles of art-making. He would write two manuals on science and art. *Underweysung der Messung mit dem Zirkel und Richtscheit* of 1522 was a manual on plane and solid geometry and geometrical construction (although he erred in analysing the ellipse as conic section) (Fig. 144). *Vier Bücher von Menschlicher Proportion* of 1528 was a manual of human proportions, a guide to the mathematically precise construction of images of men, women, and children in correct proportion (Fig. 145), following the lead of da Vinci's *Vitruvian Man* (Fig. 146).

A Northern European artist with mathematical ability would have been dissatisfied with his and others' failed efforts to capture linear perspective with geometrical accuracy, lacking training and study. By the mid-to-late 15th century, Northern Europeans knew of Italian advances with linear perspective. Deliberate efforts were made toward recreating three-dimensional scenes, like Dieric Bout's *Last Supper* of 1464-1467, which is covered with converging lines that fail to converge to one vanishing point (Fig. 147). But technical know-how was not available in Northern Europe.

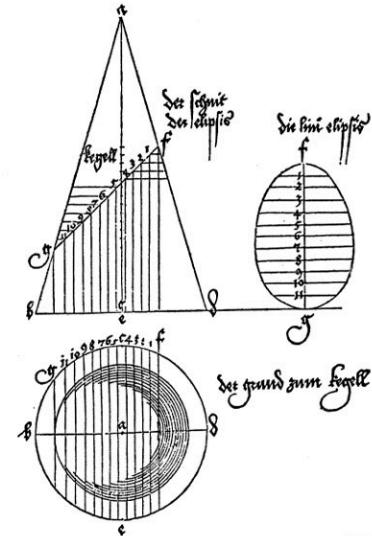
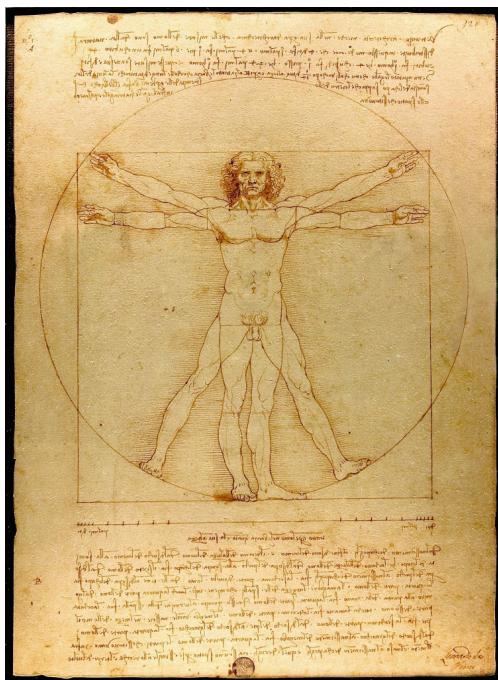


Figure 144: Method for determining oblique section of a cone from Dürer's *Underweysung*, with an incorrectly egg-shaped ellipse.

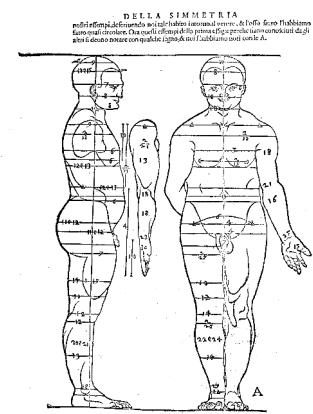


Figure 145: From Dürer's *Vier Bücher*, with an incorrectly egg-shaped ellipse.

Figure 146: Leonardo's conception of ideal body proportions, influenced by his own measurements, the drawings of his contemporaries, and the *De pictura* Alberti.

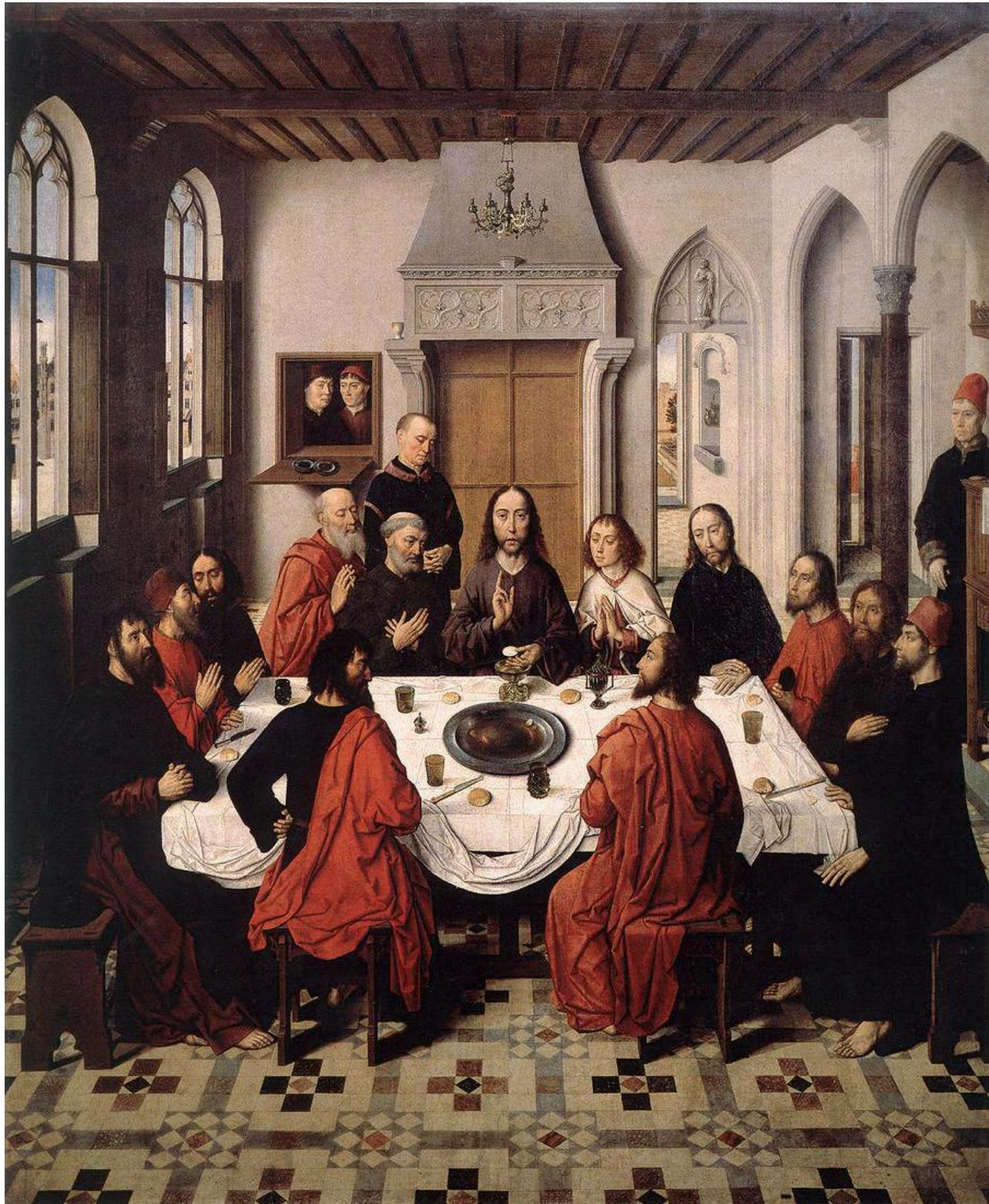


Figure 147: Altarpiece of the Holy Sacrament by Dieric Bouts [Link to Wikipedia](#)

Updated: April 1, 2024

DÜRER's *Presentation of Christ in the Temple* of 1505 is an intuitive perspective construction, with receding and sloping lines. But, like Bouts' *Last Supper*, this work also lacks consistent alignment and central vanishing point. Dürer might have been frustrated by his empirical attempts at linear perspective, and traveled to Italy in 1506 to learn its theoretical basis from experts. Writing back to Nuremberg from Venice on 13 October 1506:

I shall be finished here in ten more days, then I shall ride to Bologna where someone is willing to teach me the secrets of perspective. I intend to stay there for about eight days and then return to Venice.

Dürer succeeded. After his trip to Italy, Dürer achieved full mastery of perspective in his *St. Jerome* of 1514 (Fig. 149).



Figure 148: *The Presentation of Christ* by Dürer, 1505. The infant Jesus is brought by Mary and Joseph to Jerusalem to be consecrated to the Lord. According to the Bible, the Jewish rite of 'purification' required the sacrifice of doves or pigeons with the consecration of the baby. [Link to print at the Victoria and Albert Museum](#)



Figure 149: *St. Jerome* by Dürer, 1513.
An engraving of Saint Jerome, translator of the Bible into Latin and exemplar of Christian scholar. [Link to Metropolitan Museum of Art](#)

DÜRER TRAVELED THROUGHOUT EUROPE. Everywhere he went he took paper and purchased paper along the way. In Italy, he purchased the blue paper or *carta azzura*, the unique product of Venetian papermakers. Drawing on blue paper inspired new ways to render three-dimensional shading. His *Praying Hands* of 1508, a study for an altarpiece, is rendered lifelike by detailed hatching, white highlights, and black ink on the medium-toned blue background. Everywhere he went, Dürer took notebooks and sketchbooks, a paper trail of his movements and experiences. One sketchbook was for pen and charcoal drawings. One sketchbook was for metalpoint. Dürer traveled everywhere with sketchbooks to gather and accumulate experience and visual inspiration.

IN 1520, DÜRER TRAVELED TO ANTWERP, one of the world's busiest ports and a nexus of Northern European art in the Netherlands. He was astonished that renown preceded him in a country where art had achieved such heights. Days after he arrived, the painters' guild organized a banquet in his honor with all noblemen in attendance. Dürer wrote:

And as I was conducted to the table the company rose to their feet and lined the way, as if some great lord were entering.

Dürer was known throughout a Europe that was permeated by his works on paper. Dürer's hosts celebrated him because they had seen, owned, collected, or learned from his extensive ouvre. The global trade and emerging market for luxuries and collectibles had made Antwerp rich. His hosts were glad to celebrate their hero.

In Antwerp, Dürer sketched its port, recording the date in 1520, suggesting he was done making the picture (Fig. 151). It is a painting in perspective, along a receding diagonal, with different levels of detail given to different buildings, boats, and human figures. The lines are drawn without error or hesitation, with areas, both large and small, left purposefully empty. The drawing breaks from Northern European attention to saturating detail and from the rules of Italian perspective. He inscribed the drawing with time and place on the assumption that future viewers or (he himself) would want to know what he had seen, as well as where and when.

Dürer, author of books on geometry and anatomical proportion, was not slave to technique and precision. He wrote:

It is not my opinion that an artist has to measure his figures all the time. If thou hast learned the art of measurement and thus acquired theory and practice together... then it is not always necessary to measure everything all the time, for they acquired 'art' endows thee with a correct eye.

The mind of artists is full of images which they might be able to produce; therefore, if a man properly using this art and naturally disposed therefore, were allowed to live many hundreds of years he would be capable – thanks to the power given to many God – of pouring forth and producing every day new shapes of men and other creatures the like of which was never seen before nor thought of by any other man.



Figure 150: *Praying Hands* by Dürer.
[Link to Wikipedia](#)



Figure 151: *View of Antwerp Harbor* by Dürer, pen and ink, 1520.

LOOKING

- Joseph Koerner: Dürer's Mobility. The Linbury Lecture at the National Gallery in London. [Link to video](#)

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