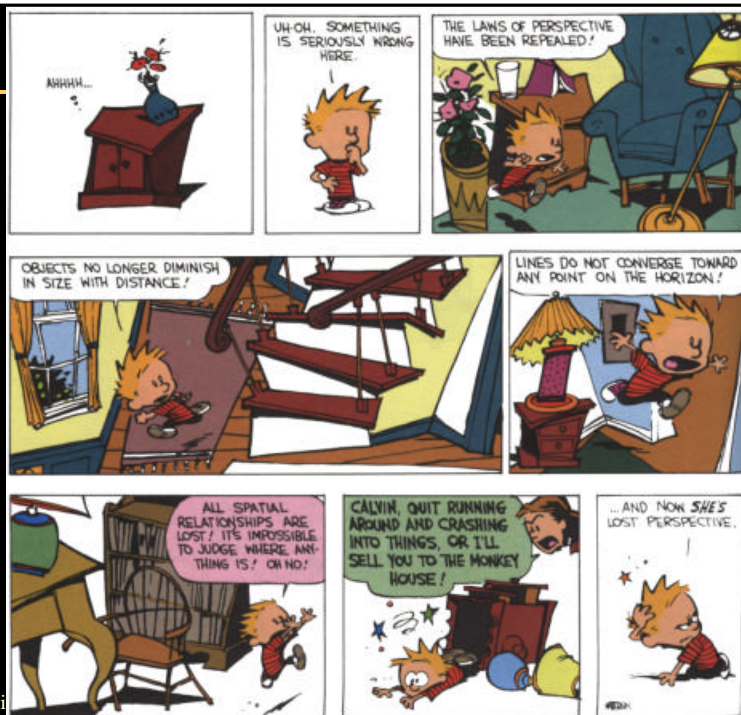


The Art and Science of Depiction
Linear Perspective

Fredo Durand
MIT- Lab for Computer Science



Perspecti

2

Assignments for Monday 30.

- Solso *Cognition and the Visual Arts*
 - Chapter 8 & 9
- Final project
 - Firm subject

Plan of the next sessions

- Drawing and projection
- Denotation
- Tone & color

Plan

- Intro to perspective
- History of Renaissance perspective
 - Early attempts
 - Bruneleschi
 - Alberti
 - De la Francesca
 - Leonardo
 - Dürer
- Gadgets
- Distortion issues

Perspective

- Does linear perspective “occur” in nature
 - E.g. we “experience” foreshortening
- Perspective or perspectives?

Pictorial depth cues

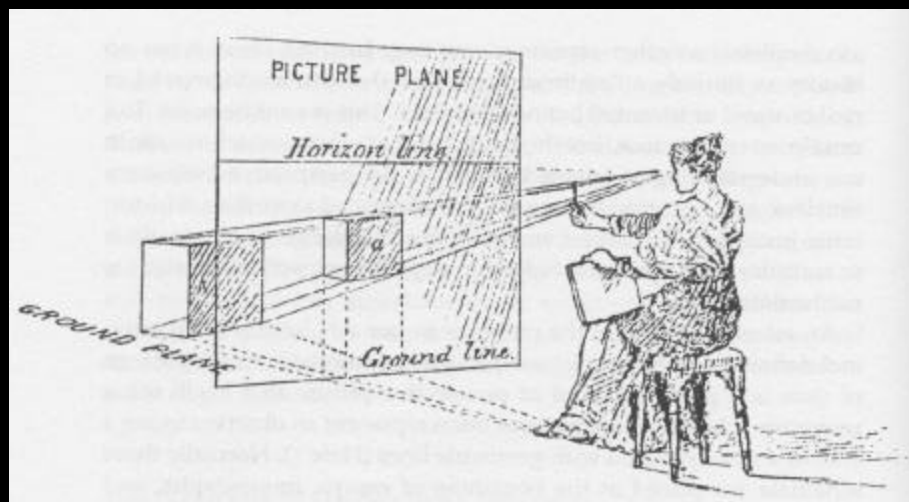
- Occlusion
- Size
- Position relative to the horizon
- Convergence of parallels, linear perspective
- Shading, shadow
- Texture gradient
- Aerial perspective

Perspective

7

Introduction to Perspective

- Importance of the single viewpoint

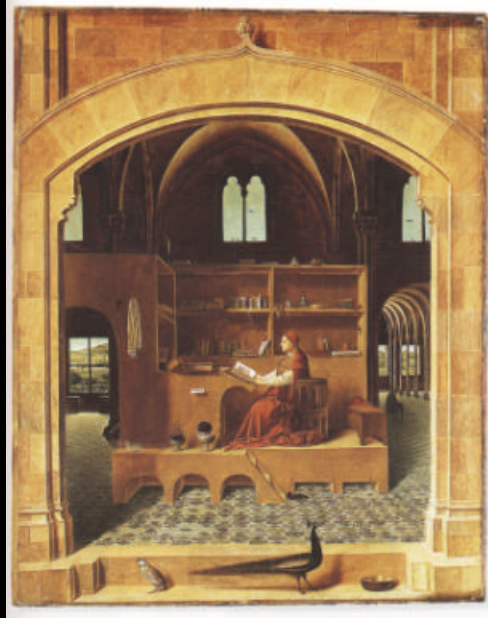


Perspective

8

Linear Perspective

- Image as a window
- *St Jerome In His Study*
Antonello da
Messina 1475



Perspective

9

Some accompanying concepts

- Viewpoint
- Foreshortening
- Vanishing point

- Very linked to architectural spaces

Perspective

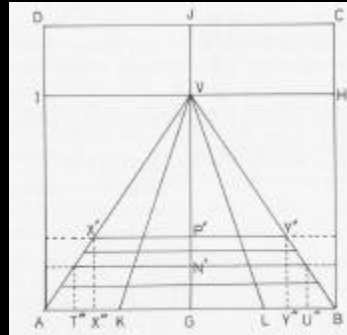
10

Primary/secondary geometry

- Primary geometry
 - Description in 3D object-space
- Secondary geometry
 - Description in 2D image-space



Perspective



11

Plan

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Perspective

12

Early attempts

- St John the Baptist Retiring to the Desert
Giovanni di Paolo 1454



Perspective

13

Early attempts

- Giotto, 1297-1299



Perspective

14

Early attempts

- Lorenzetti 1337-1340

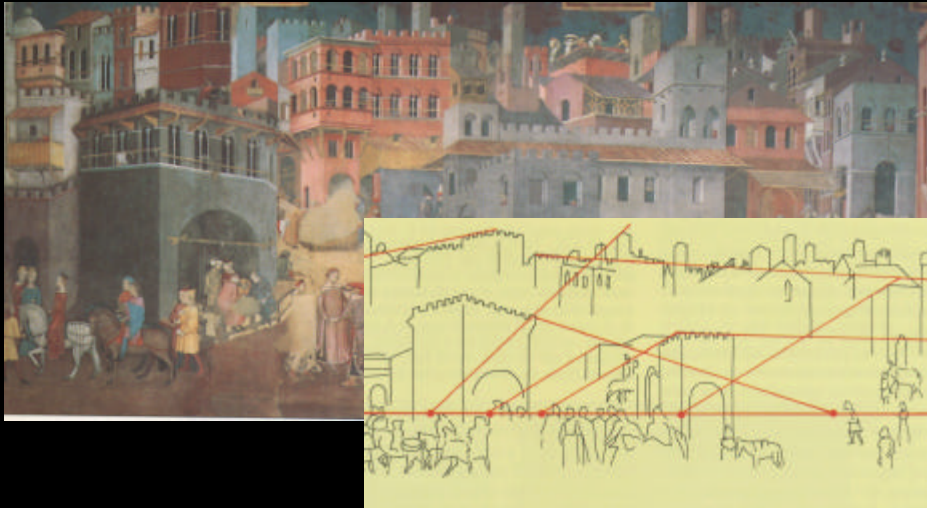


Perspective

15

Early attempts

- Lorenzetti 1337-1340



Perspective

16

Giotto's rules

- Lines and planes above eye level incline downwards when they move away
- Below eye level upwards when they move away
- Lines to the left incline inwards to the right

Perspective

17

Giotto

- Confirmation of the Rule of St Francis 1325

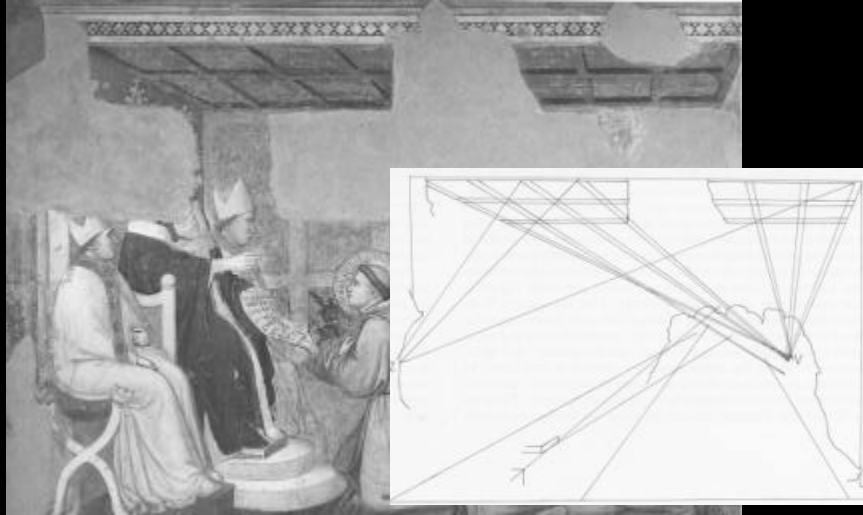


Perspective

18

Giotto

- Confirmation of the Rule of St Francis 1325



Perspective

19

Early attempts

- Pietro Lorenzetti,
Birth of the Virgin
1342



Perspective

20

Plan

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Bruneleschi's experiments, 1413

- Existing buildings
- Measurement, surveying
- Single viewpoint
- First scientific mimesis

Bruneleschi's experiment, 1413



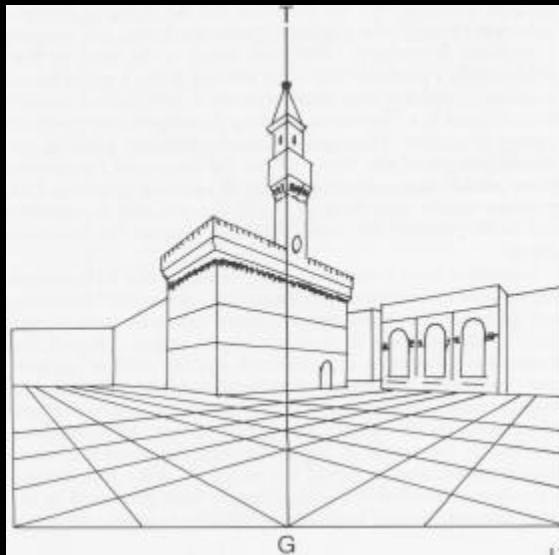
Perspective



23

Bruneleschi's second experiment

- Cut out
- Note that this is 2-point perspective



Perspective

24

Limitations

- Existing buildings
- Requires measurement

Perspective

25

Masaccio, The Trinity, 1427

- The oldest perspective painting
- Probably measurement
- Maybe helped by Brunelleschi



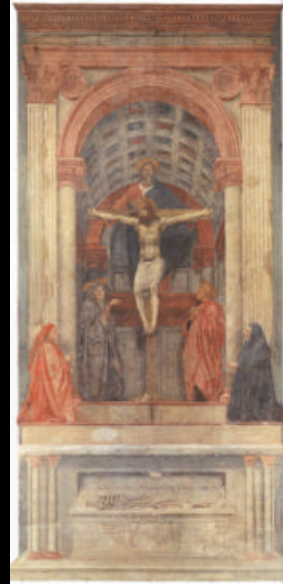
Perspective

Masaccio, *The Trinity*, 1427

- The oldest perspective painting
- Santa Maria Novella (Florence)



Perspective



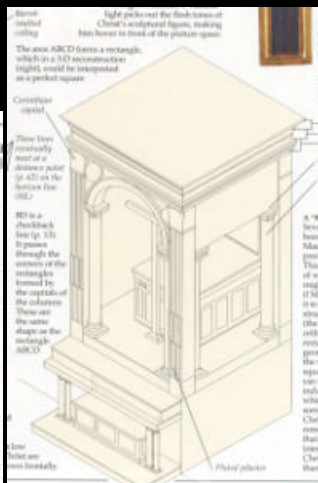
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Masaccio, *The Trinity*, 1427

- The oldest perspective painting



Perspective



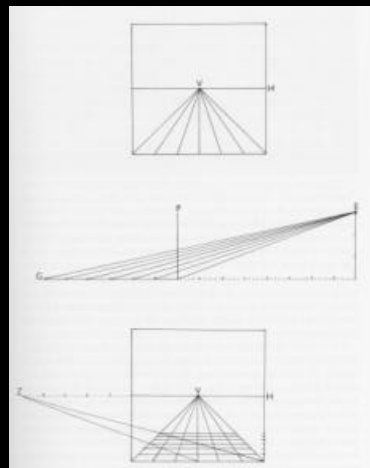
28

Plan

- Intro to perspective
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 - Dürer
- Gadgets
- Distortion issues

Leon Battista Alberti, On Painting

- 1435
- Intersections of pyramids with image surface
- Proportional triangles
- Use side view for foreshortening
- Check with diagonal
- Use pavement as reference
- Center = prince of rays



Leon Battista Alberti, On Painting

- Paolo Uccello, *The Selling of the Host*, 1468



Perspective

31

Legitimate construction

- Carlo Crivelli
Annunciation 1486



Perspective

Plan

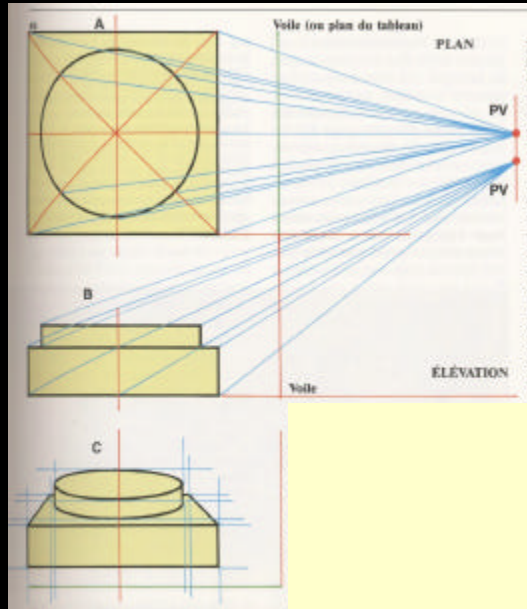
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Piero de la Francesca

- *De Prospectiva Pingendi*, 1474
(On the perspective of painting)
- Ratios of distance and size
- Use plan and elevation view

Piero de la Francesca

- Use plan and elevation view

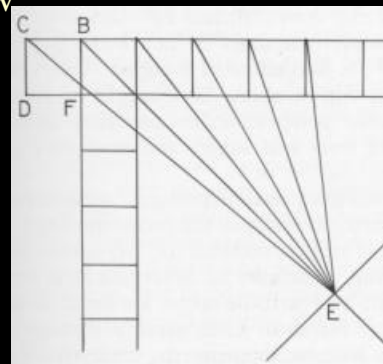


Perspective

35

Piero de la Francesca

- *De Prospectiva Pingendi*, 1474
(On the perspective of painting)
- Ratios of distance and size
- Use plan and elevation view
- Deformation of square
 - Angle of view less than 90°

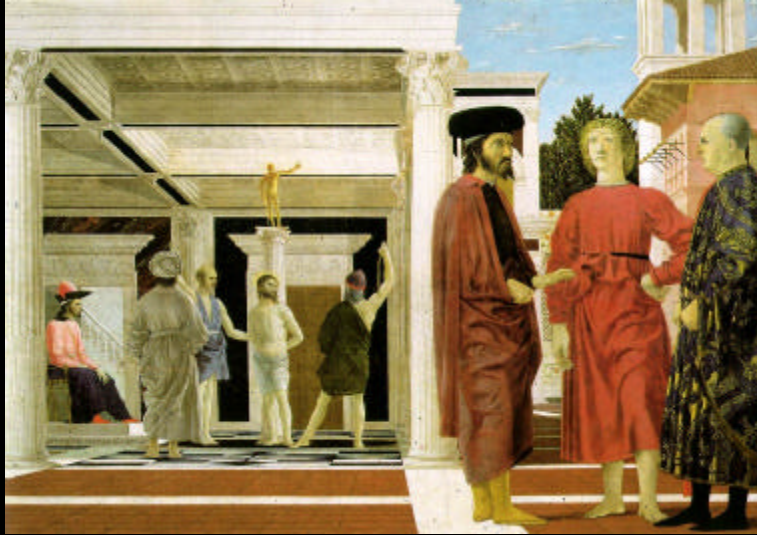


Perspective

36

Piero de la Francesca

- *Flagellation of Christ, 1460*



Perspective

37

Piero de la Francesca

- Invention of the true cross 1452-59
- “wrong perspective on the left



Perspective

38

Piero de la Francesca

- Invention of the true cross 1452-59
- “wrong perspective on the left



Perspective

39

Plan

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- Distortion issues

Perspective

40

Leonardo & perspective

- Techniques of artists' perspective in theory and practice
- Geometry of visual rays
- Devices and instruments
- Optics and the eye
- Curiosities of vision (e.g. anamorphosis)
- Apparent contradictions

Perspective

41

Leonardo

- *Last Supper*, 1497



Perspective

42

Leonardo

- *Last Supper*, 1497

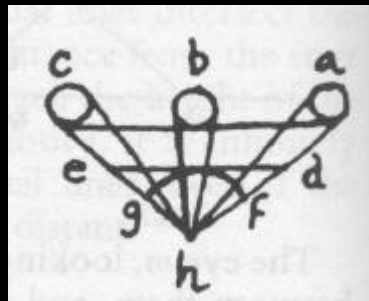
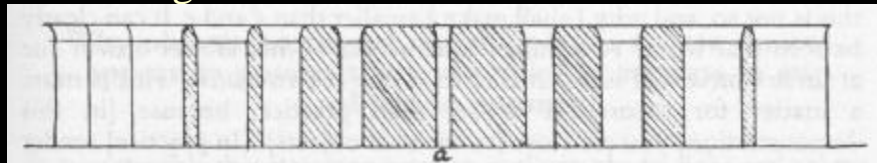


Perspective

43

Leonardo & contradictions

- Wide angle vision

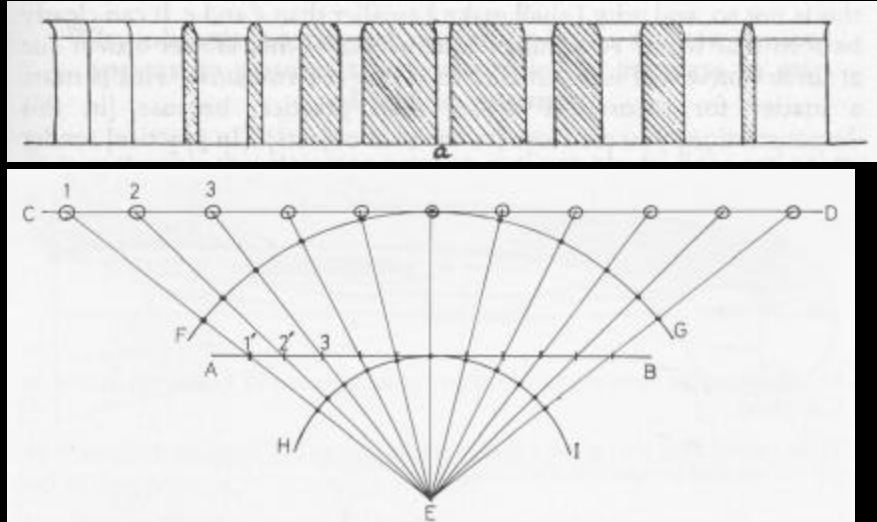


Perspective

44

Leonardo & contradictions

- Wide angle vision

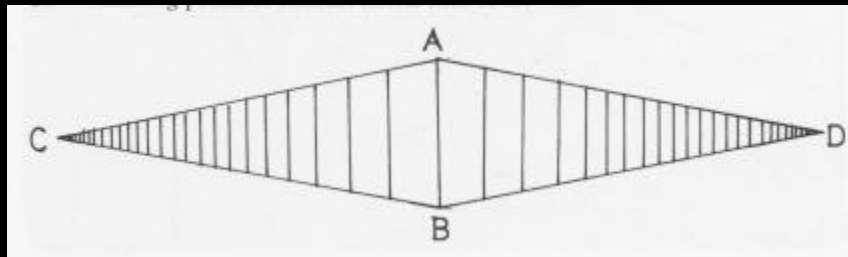


Perspective

45

Leonardo & contradictions

- Wide angle vision
- Lateral recession



Perspective

46

Plan

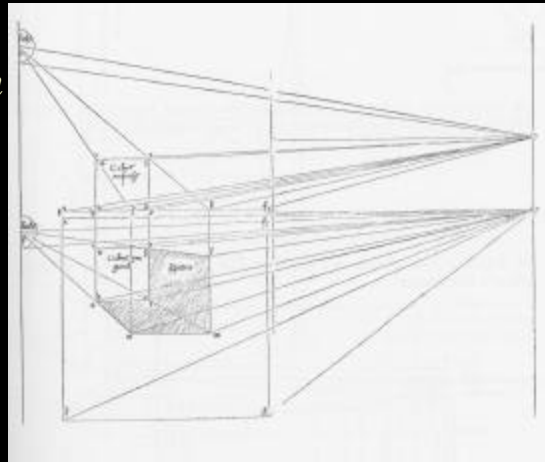
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Perspective

47

Dürer

- Traveled to Italy
- Mainly influenced by de la Francesca
- *Instruction in Measurement with Compass and Ruler in Lines, Planes and Solid Bodies, 1525*



Perspective

48

Dürer

- *St Jerome in his Study* 1514
- Very off-center
- Note the verticals



Perspective

49

Dürer

- The artist's glass

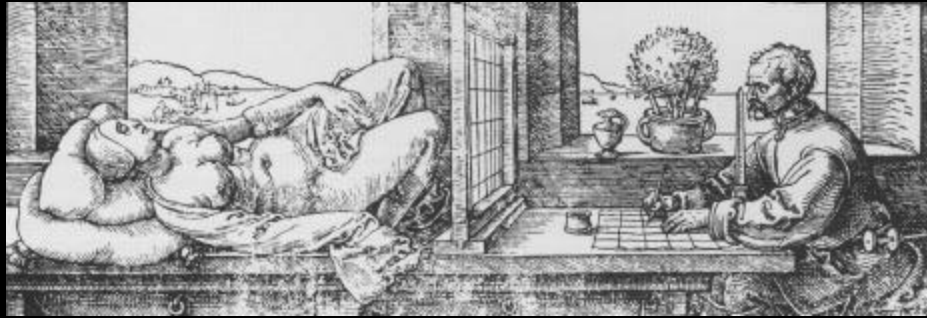


Perspective

50

Dürer

- The draftsman's net



Perspective

51

Dürer

- Jacob de Keyser's invention

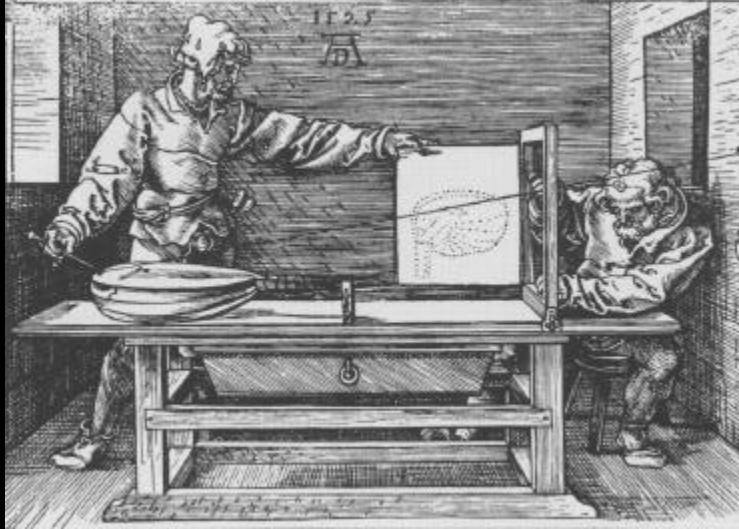


Perspective

52

Dürer

- Dürer's device



Perspective

53

Conclusions about Renaissance

- Different techniques, refinement
- Measurement
- Mainly central perspective
- No notion of infinity, no vanishing point
- Spiritual notion of mathematical harmony

Perspective

54

After Renaissance

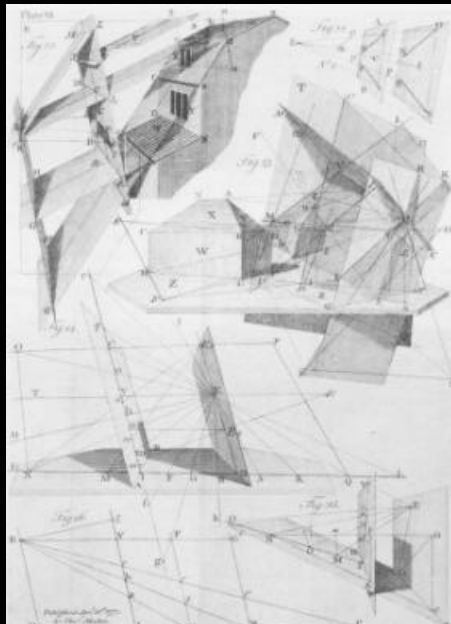
- 17th
 - Vanishing point
 - Abstraction
 - Desargues, Descartes
- Flourished until 19th
- 20th century
 - Come-back for computer graphics and computer vision

Perspective

55

After Renaissance

- Thomas Malton
*A Complete Treatise
on Perspective, 1779*



Perspective

Plan

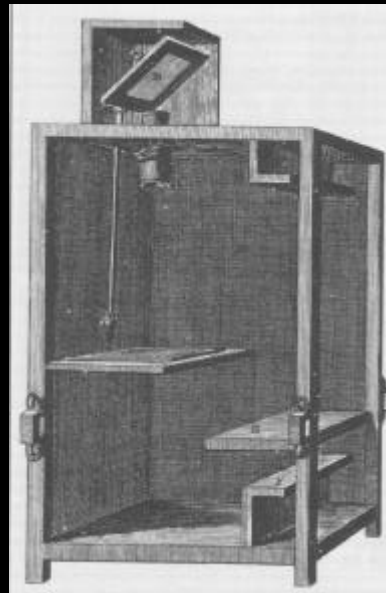
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Perspective

57

Gadgets

- Camera obscura



Perspective

58

Vermeer 1660

- Camera obscura



Perspective

59

Gadgets

- Baldassare Lanci's universal instrument for surveying and perspective 1557

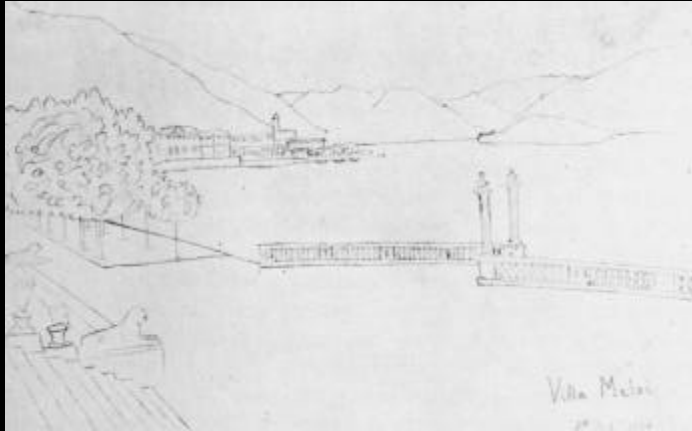


Perspective

60

Gadgets

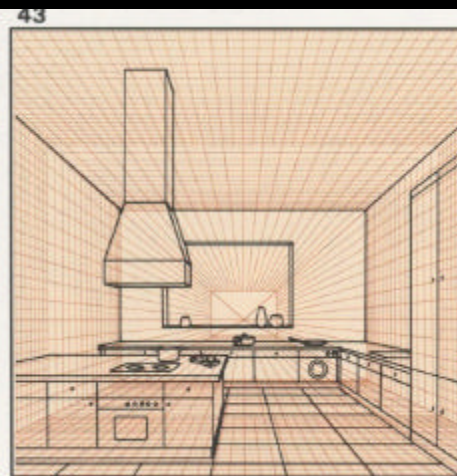
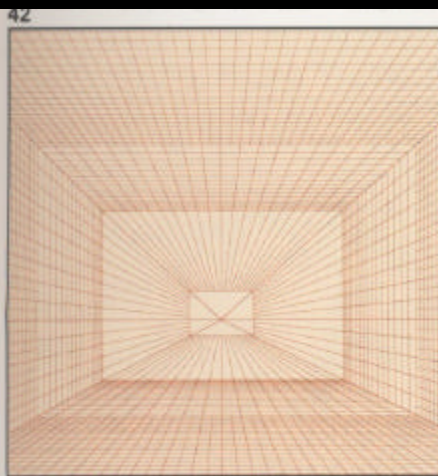
- Camera Lucida
- E.g. Talbot



Perspective



Perspective grids



Perspective

62

Plan

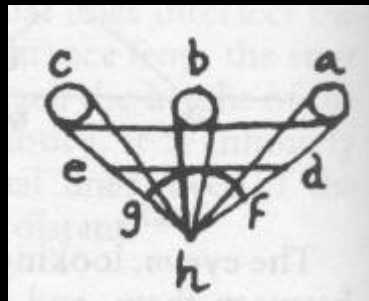
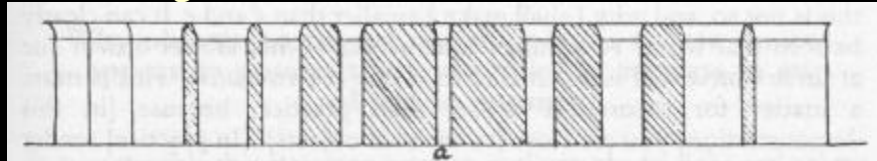
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Perspective

63

Leonardo & contradictions

- Wide angle vision

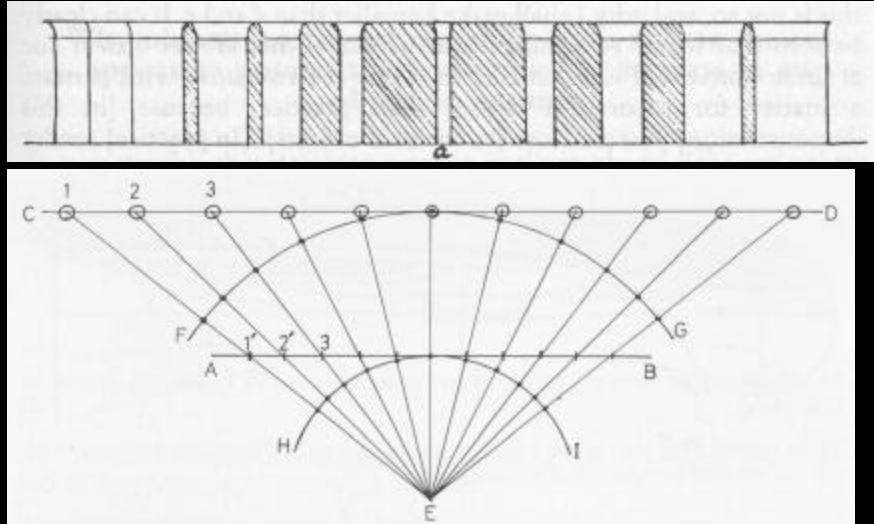


Perspective

64

Leonardo & contradictions

- Wide angle vision

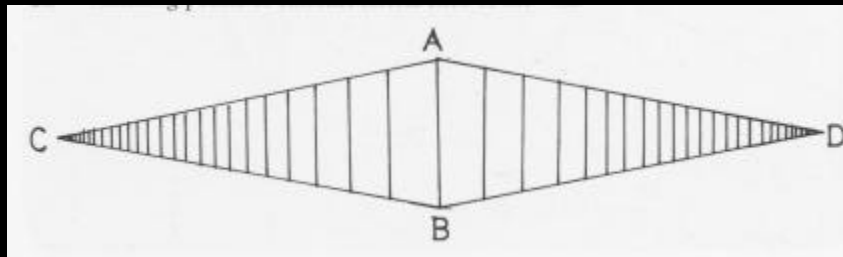


Perspective

65

Leonardo & contradictions

- Wide angle vision
- Lateral recession



Perspective

66

Perspective distortion

- The sphere is projected as an ellipse



Perspective

67

Perspective distortion

- The sphere is projected as an ellipse



Perspective

68