

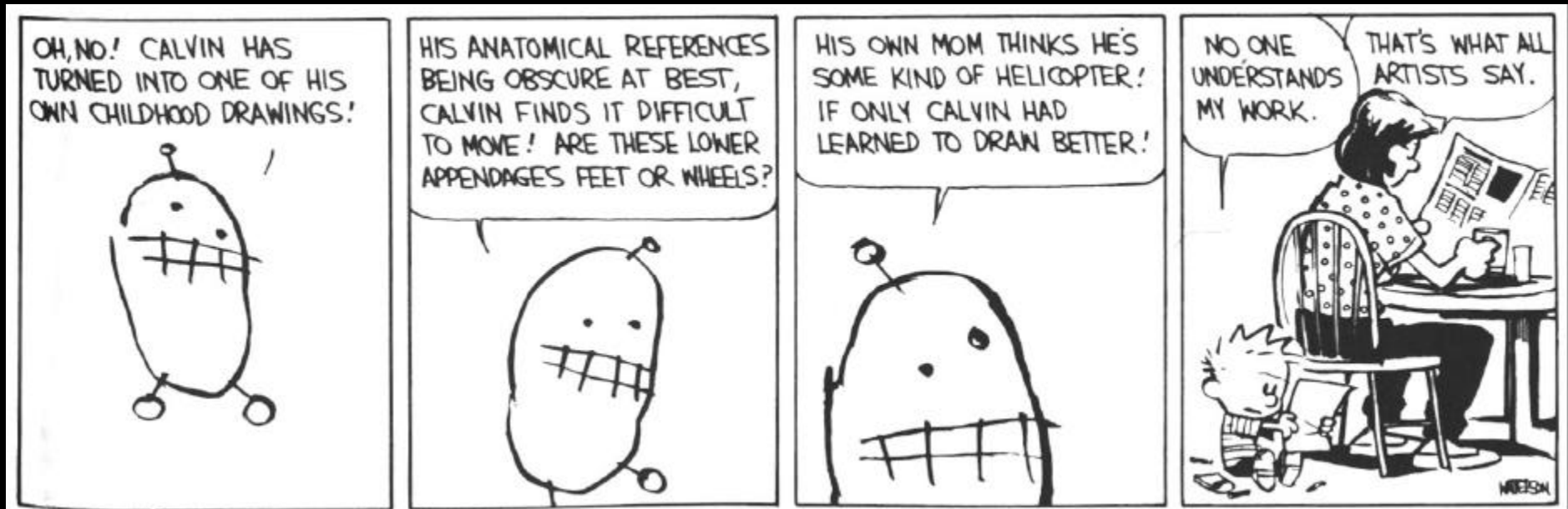
The Art and Science of Depiction

*Non-linear
Drawing systems*

Fredo Durand

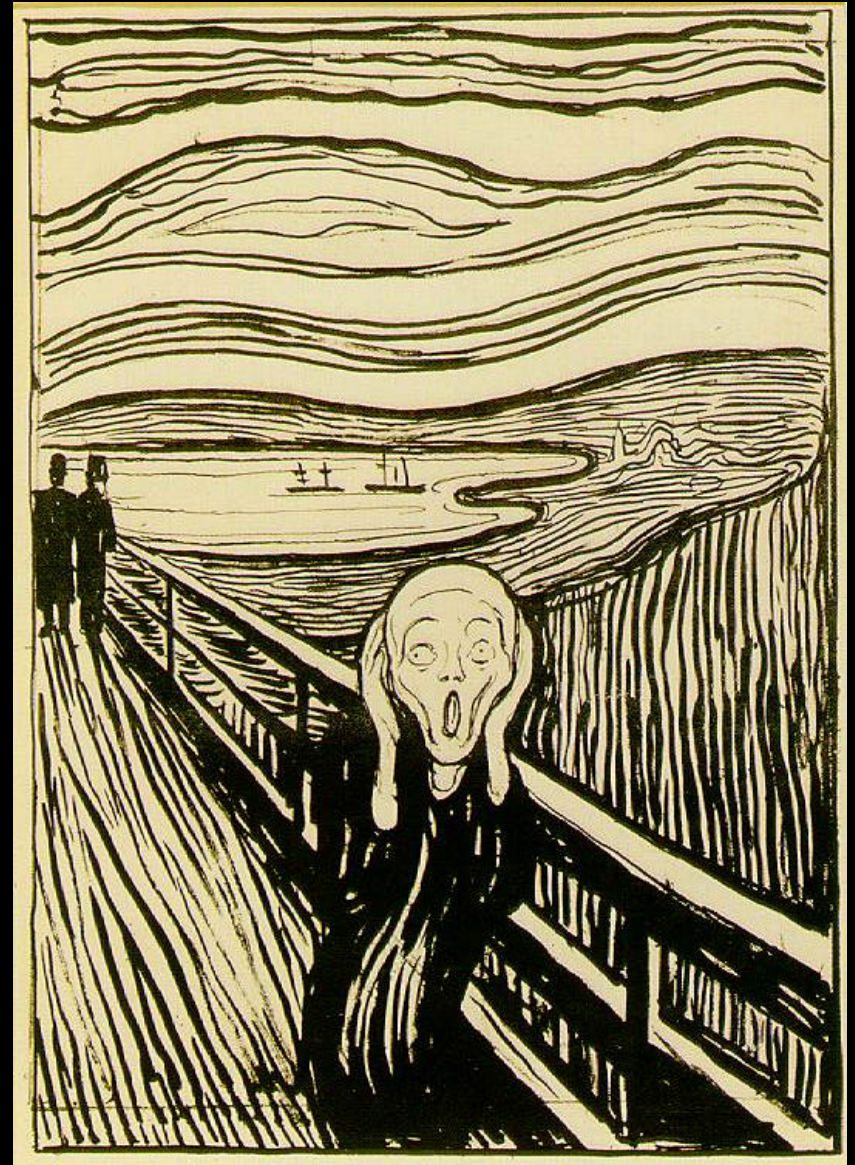
MIT- Lab for Computer Science

Non-linear drawing systems

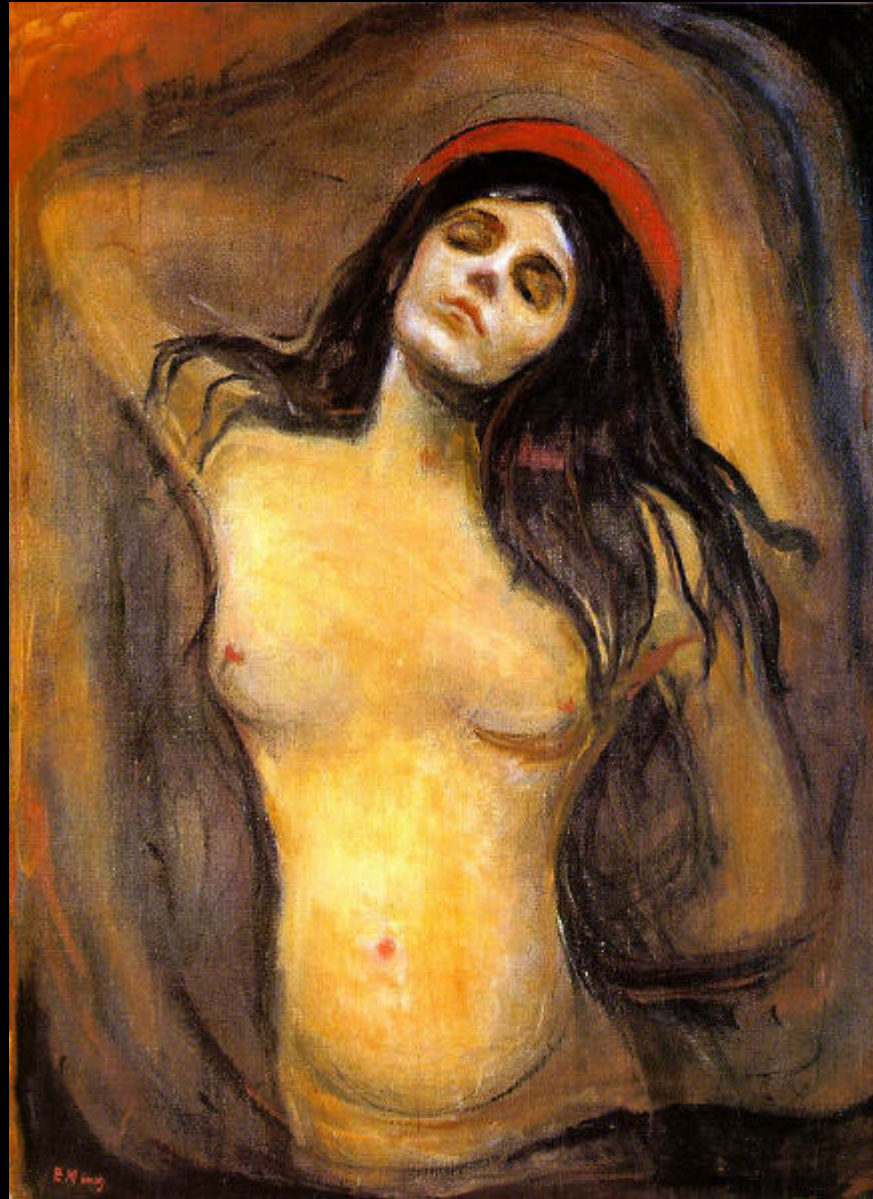


Munch exhibition

- Boston College
- Until May 21.
- Birth of expressionism



Munch



Munch



Munch



Munch



Drawing systems

Munch

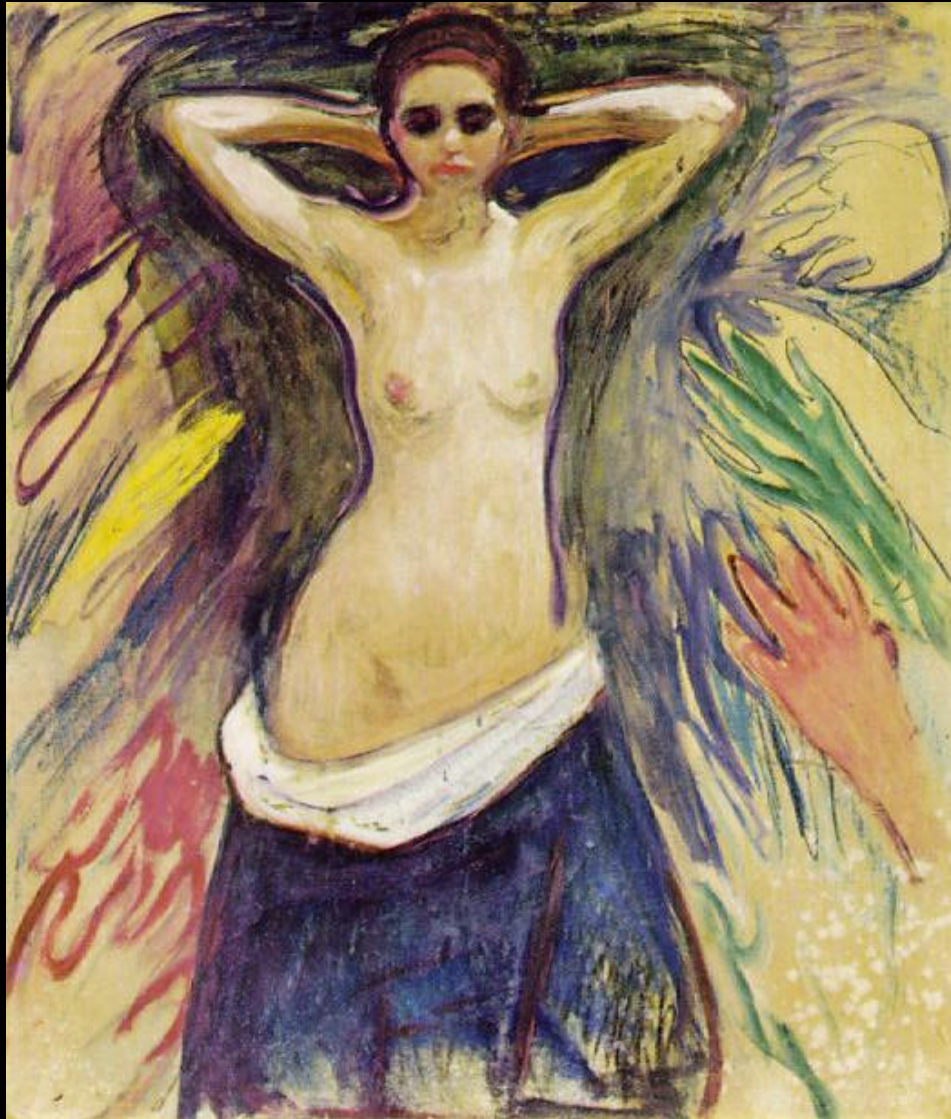


Drawing systems

Munch



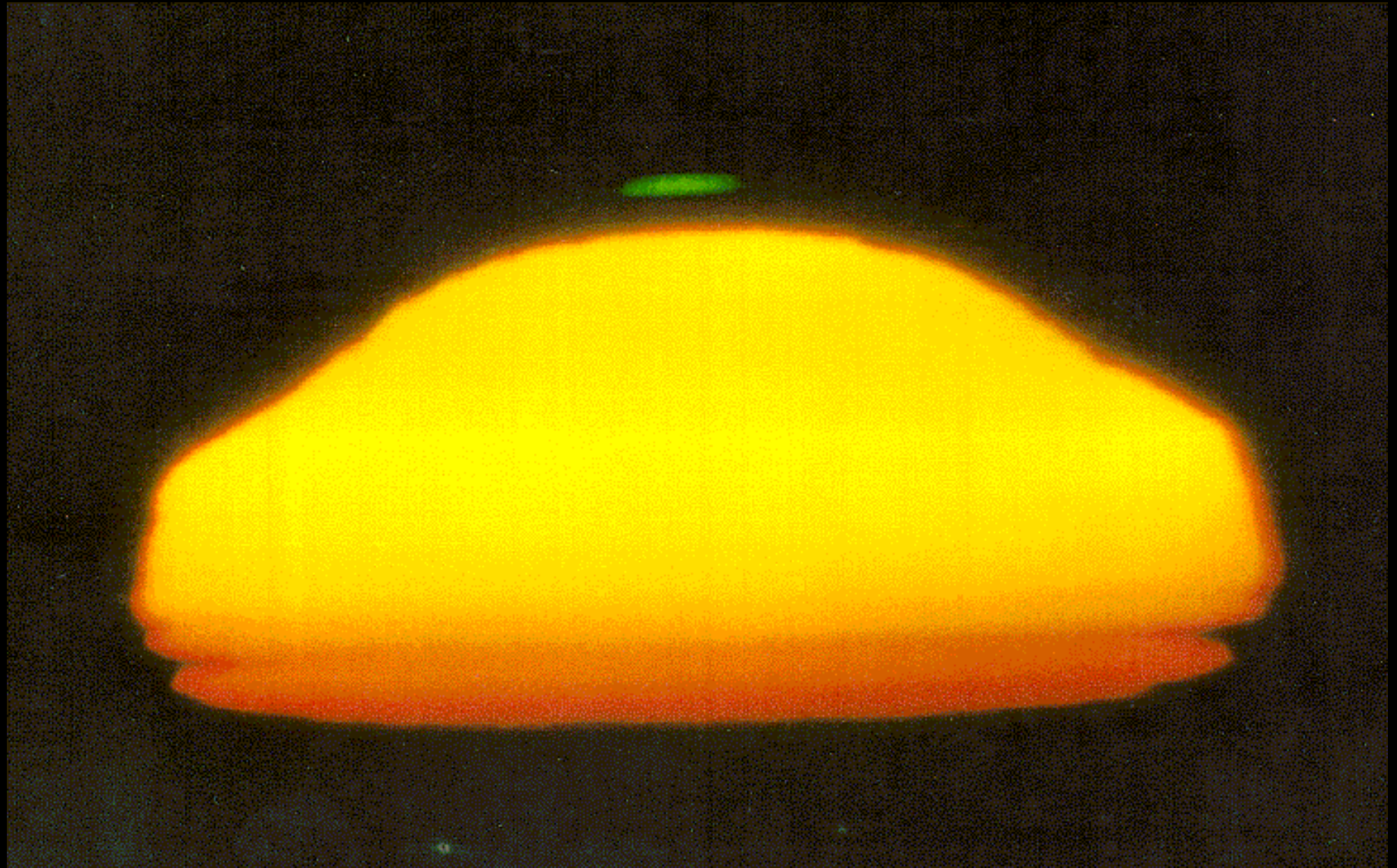
Munch



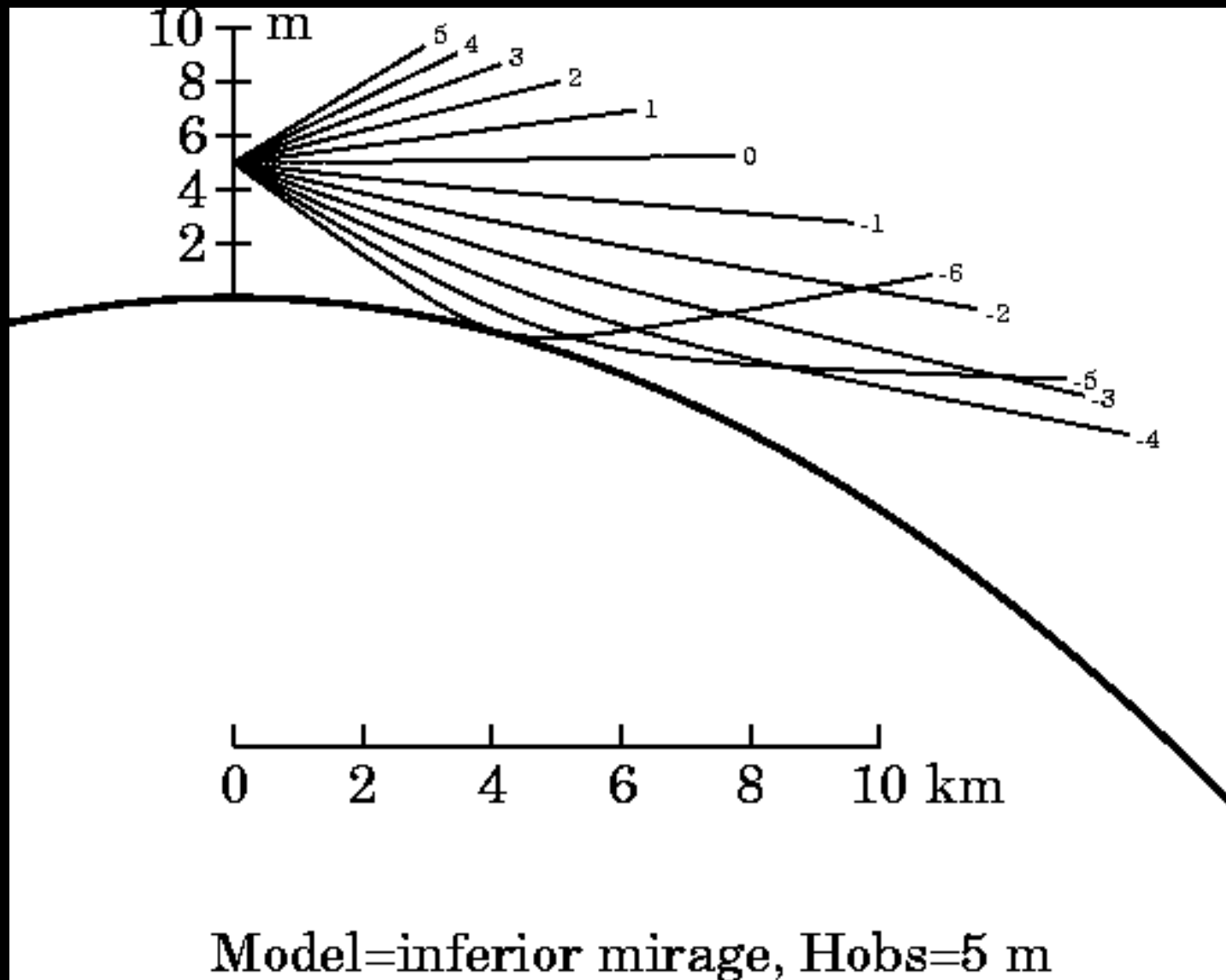
Green flash



Green flash



Green flash



Green flash

INFERIOR-MIRAGE

SUNSET

for

$L = -10$ m

seen from 4 m



Green flash

**INFERIOR-MIRAGE
GREEN FLASH**

for

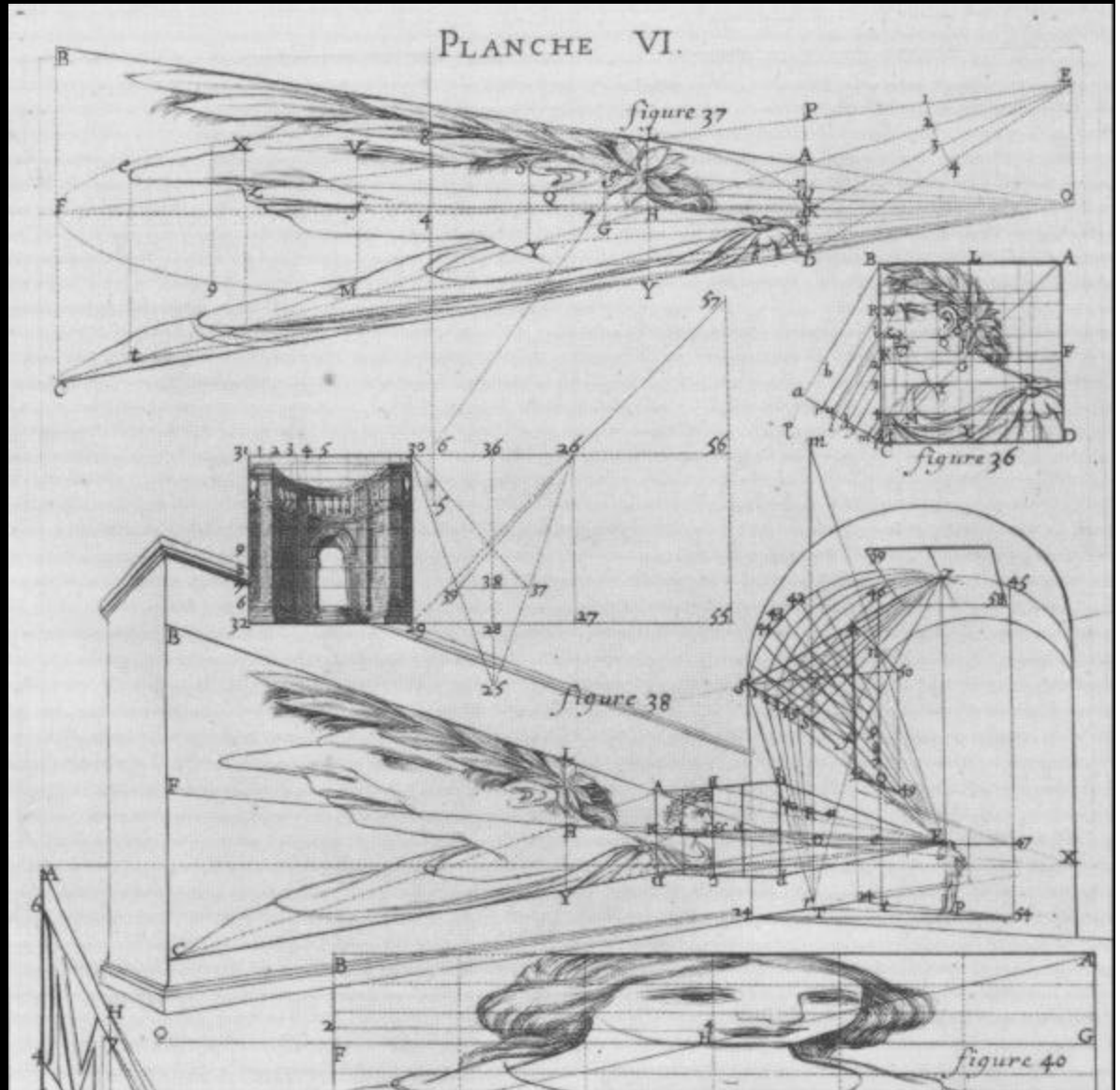
$L = -10$ m

seen from 4 m



Anamorphosis

- Gregoire Huret
1670



Plan

- Drawing and projection
 - Linear perspective & the Renaissance
 - Drawing systems
 - Catalogue of “all” drawing systems
 - Advantage/disadvantages
 - Distortion and constraints
- Denotation
- Tone & color

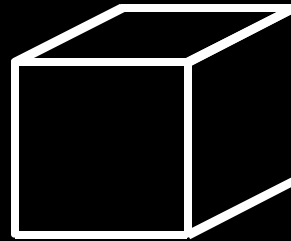
Classification of drawing systems

- Linear
 - Parallel
 - Orthogonal
 - Fold-out oblique
 - Horizontal oblique
 - Vertical oblique
 - Orthographic
 - Isometric
 - Others
 - Non orthogonal
 - Oblique
 - Axonometric
 - Linear perspective
 - One point
 - Two points
 - Three points
 - Divergent perspective
- Non Linear
 - Quasi linear
 - Naïve perspective
 - Expressionist perspective
 - Importance-driven
 - Cell panorama
 - Curved projections
 - Panorama
 - Fish-eye
 - Topological
 - Split views, fold-out
 - Multiple viewpoints

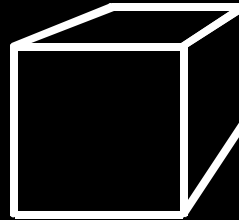
Linear projections

- Straight lines and alignments are preserved
- Can be expressed in primary geometry
 - Ray-image intersections
 - A matrix

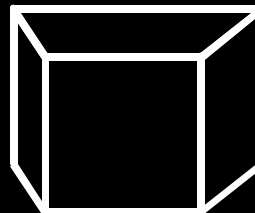
- Parallel



- Linear perspective



- Divergent perspective



Classification of drawing systems

- Linear
 - Parallel
 - Linear perspective
 - Divergent perspective
- Non Linear
 - Quasi linear
 - Curved projections
 - Topological
 - Split views, fold-out
 - Multiple viewpoints

Non Linear

- Does not preserve straight lines
- Can get rid of some distortions
- More freedom
- Dramatic effects

Non Linear

- Quasi linear
- Curved projections
- Topological
- Split views, fold-out
- Multiple viewpoints

Quasi linear

- Locally linear
- Preserves the drawn straight lines
- No “accurate” space
- Unified space

Quasi linear

- Naïve perspective
- “Expressionist” perspective
- Importance-driven
- Locally linear
- Cell panorama

Naïve perspective

- Attempt to depict scene 3 dimensionally
- Often lack of skill
- More or less formal secondary geometry rules

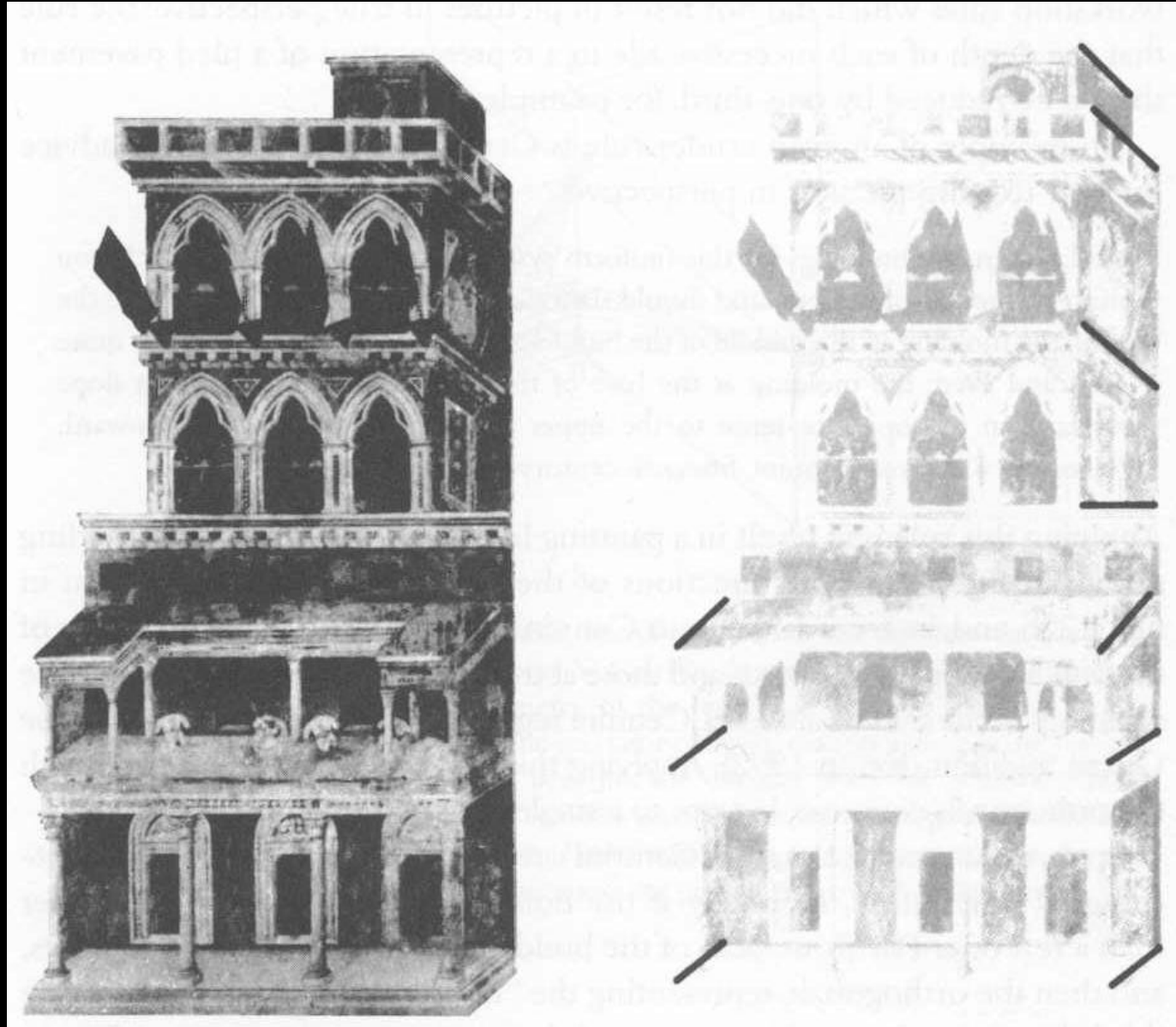
Naïve perspective

- Pompeii



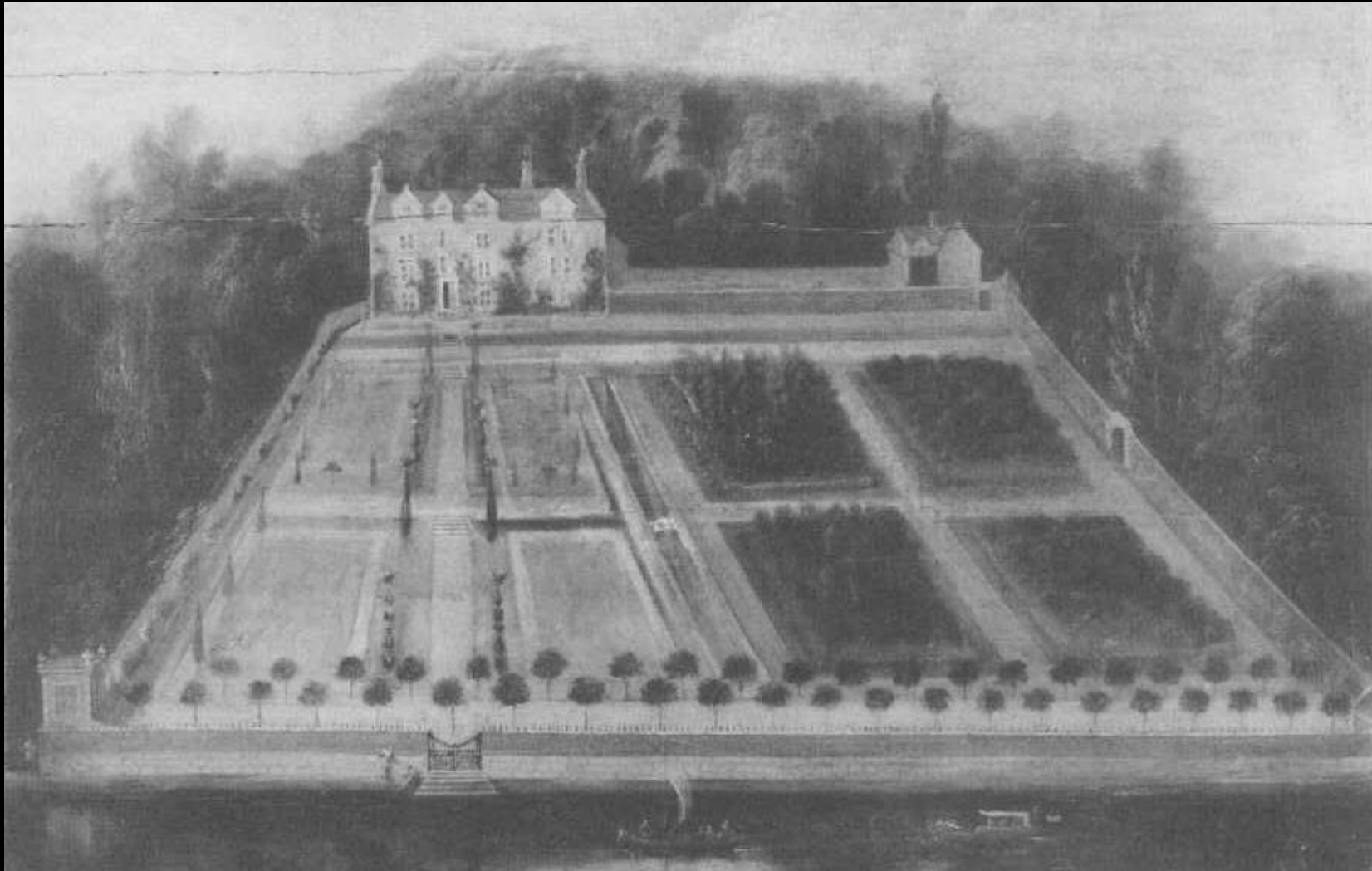
Naïve perspective

- Giotto



Naïve perspective

- 18th century

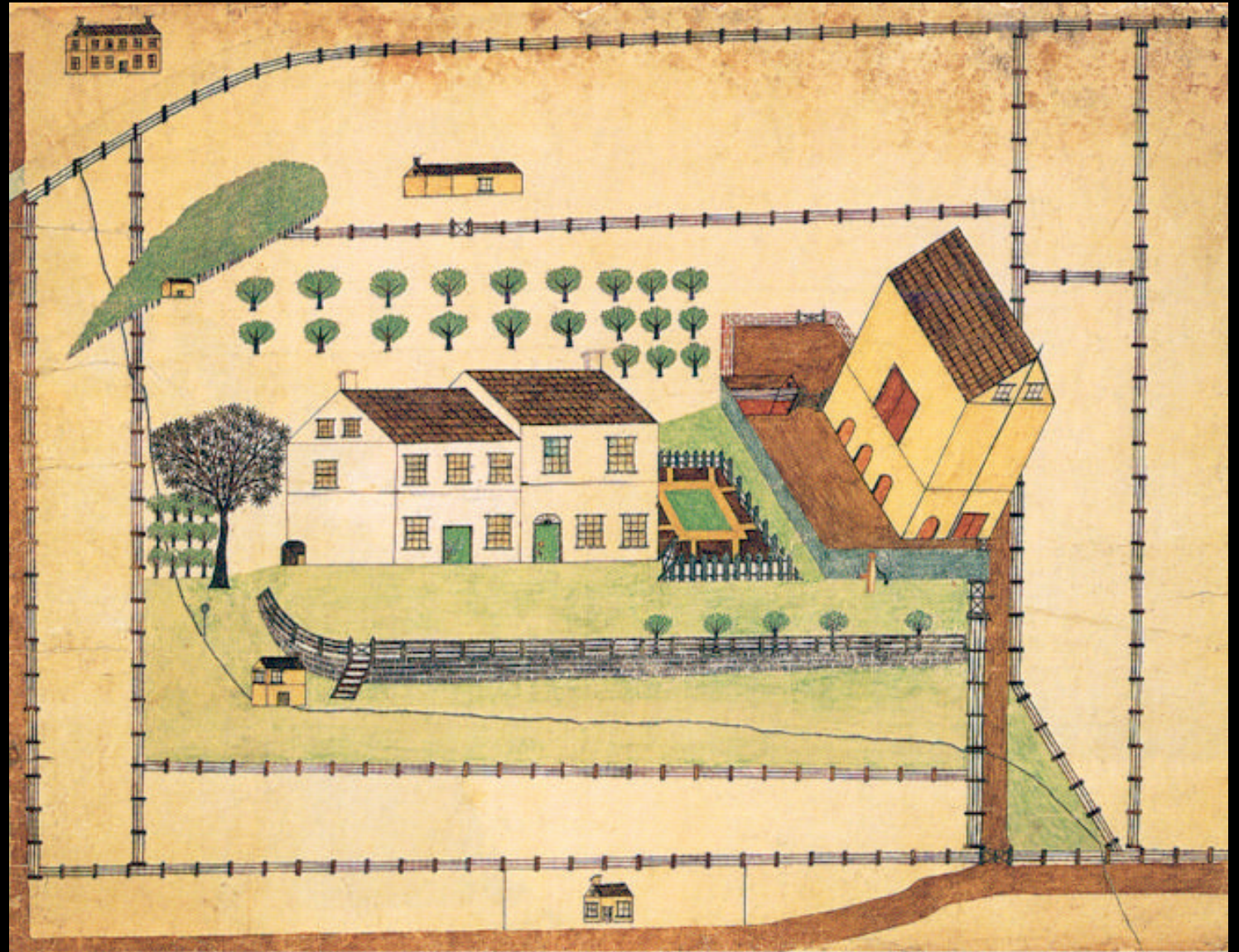


Locally linear

- Linear for objects or parts of the scene
- Choose the best system for each part
- Allows different scales, provide context
- In fact, this is the most common system!

Locally linear

- Folk



Locally linear



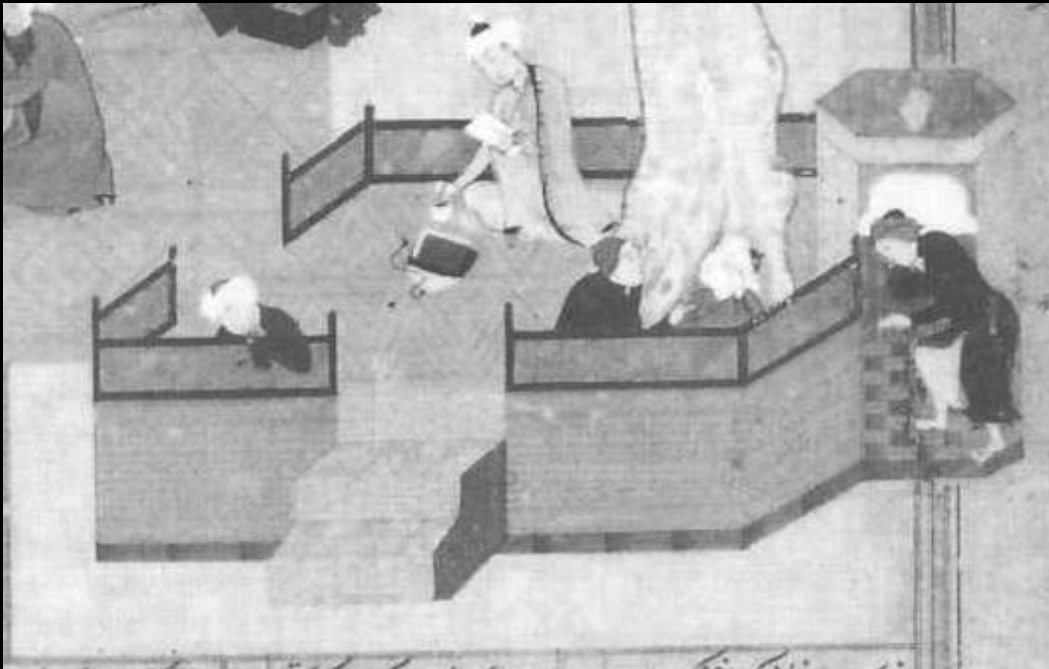
Locally linear

- Egyptian
- Best view for each object

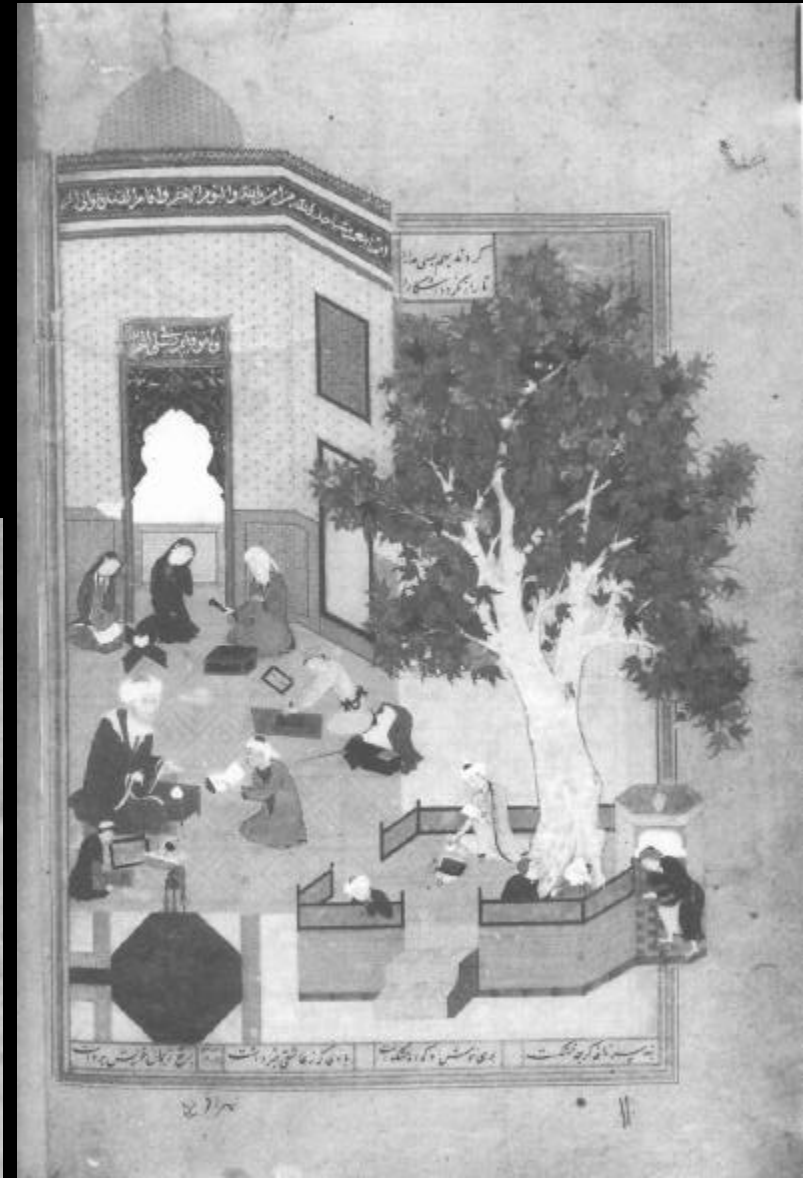


Locally linear

- Persian miniature, 1494
- Oblique+vertical oblique



Drawing systems

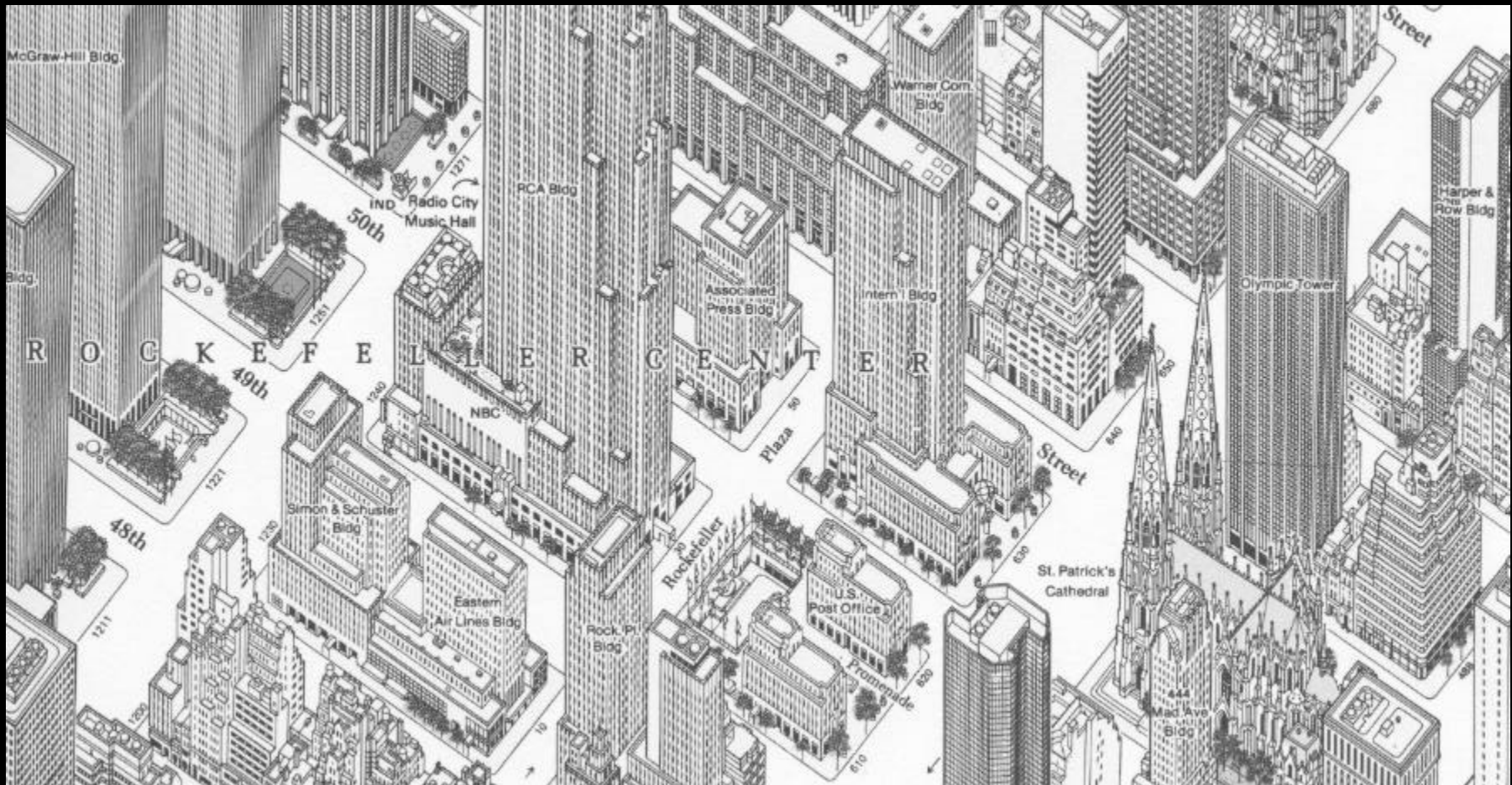


Locally linear



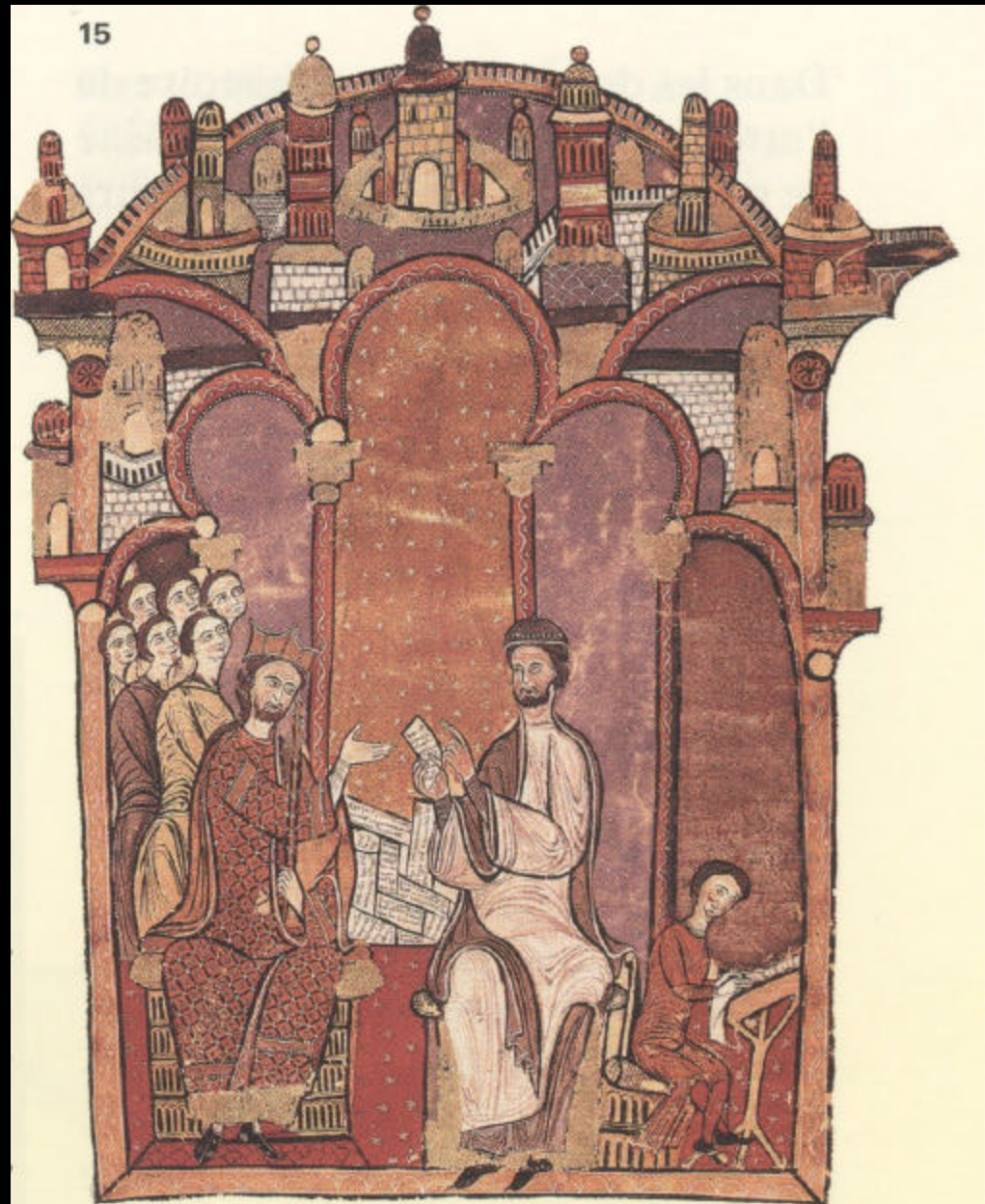
Locally linear

- Plan of Manhattan



Locally linear

- Llibre Dels Feus
1162-1199



Locally linear

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



Locally linear

- Raphael, The School of Athens



Importance-driven

- Size depends on importance, symbol

Importance-driven



Drawing systems

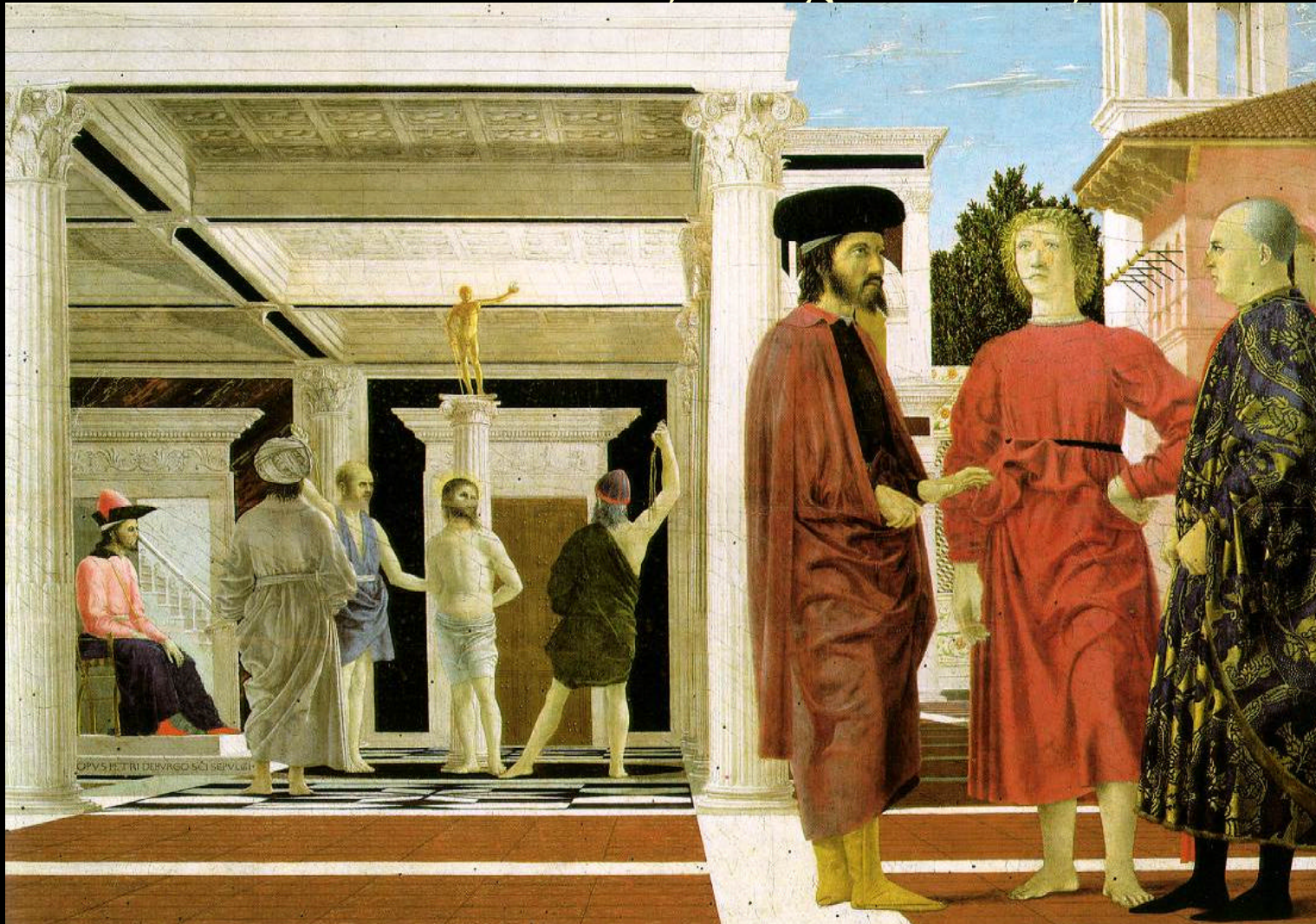
Importance-driven

- Piero de la Francesca
Mercy



Comparison

- Piero de la Francesca , *Flagellation*, 1460



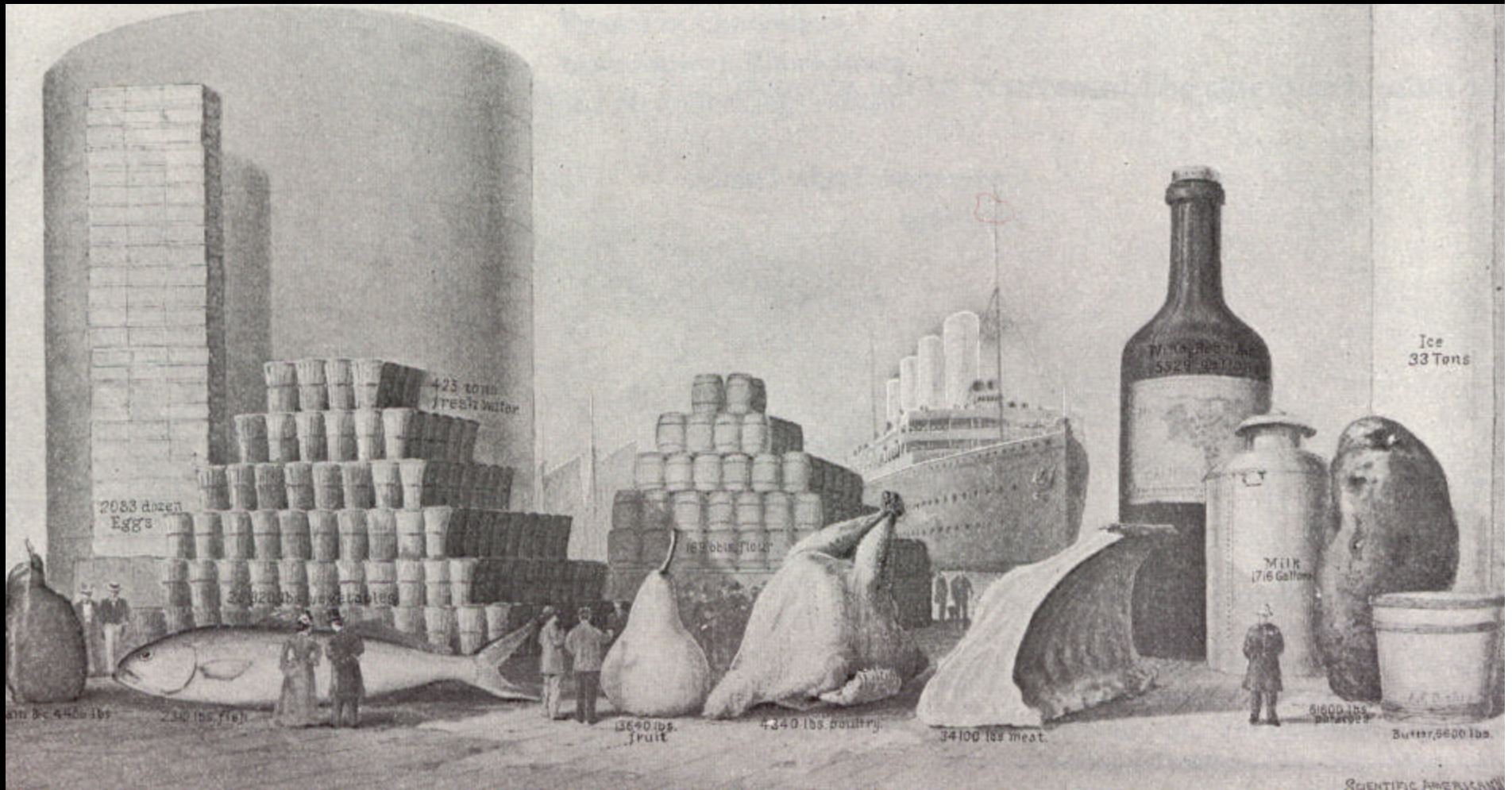
Importance-driven



Drawing systems

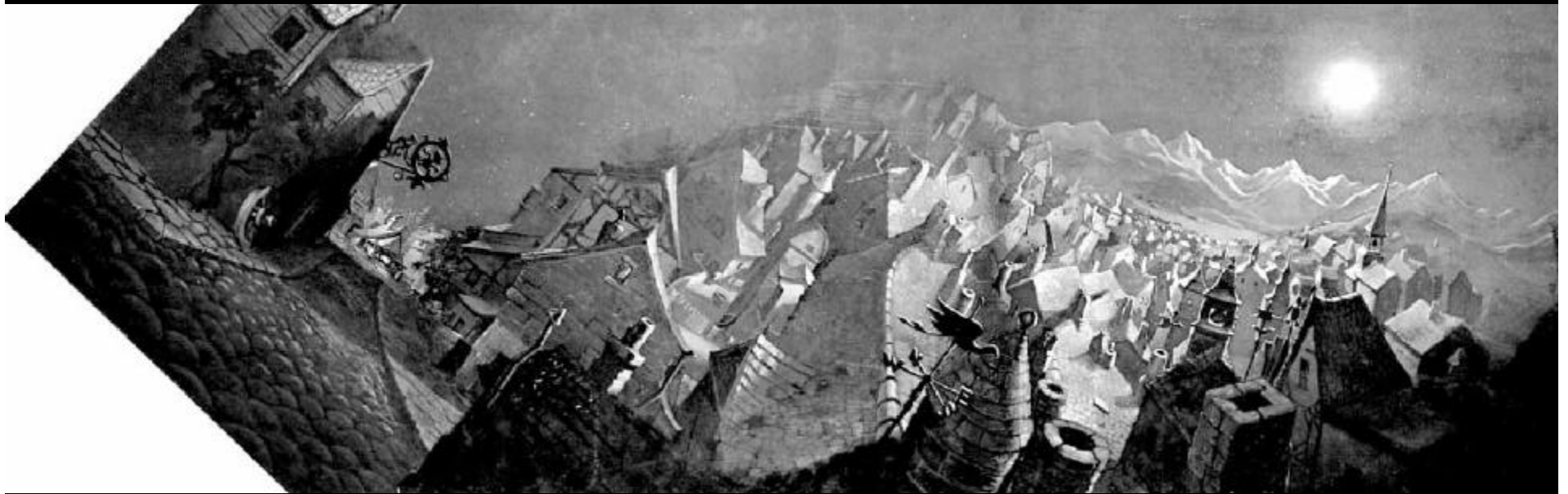
Data-driven

- Scientific American



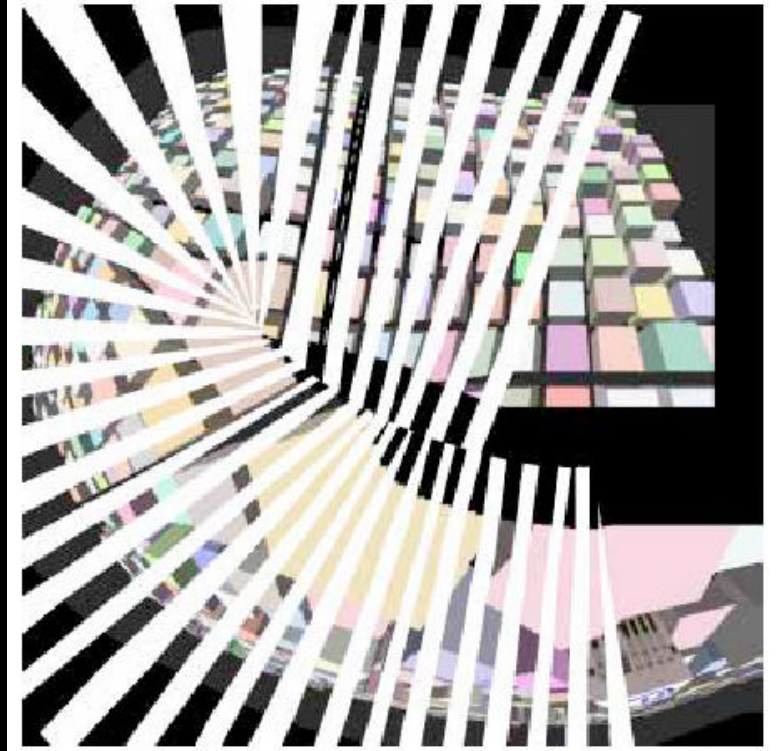
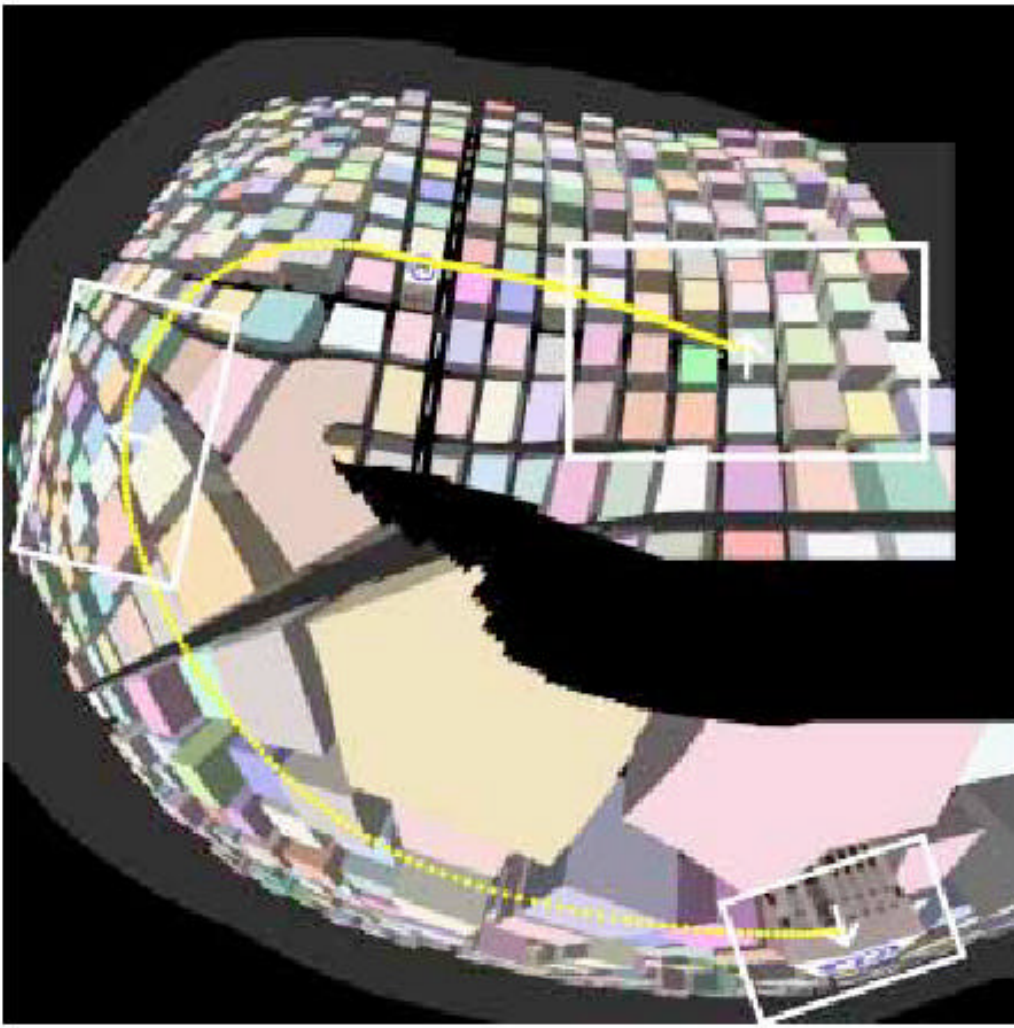
Cell multiperspective panorama

- Pinocchio, Walt Disney



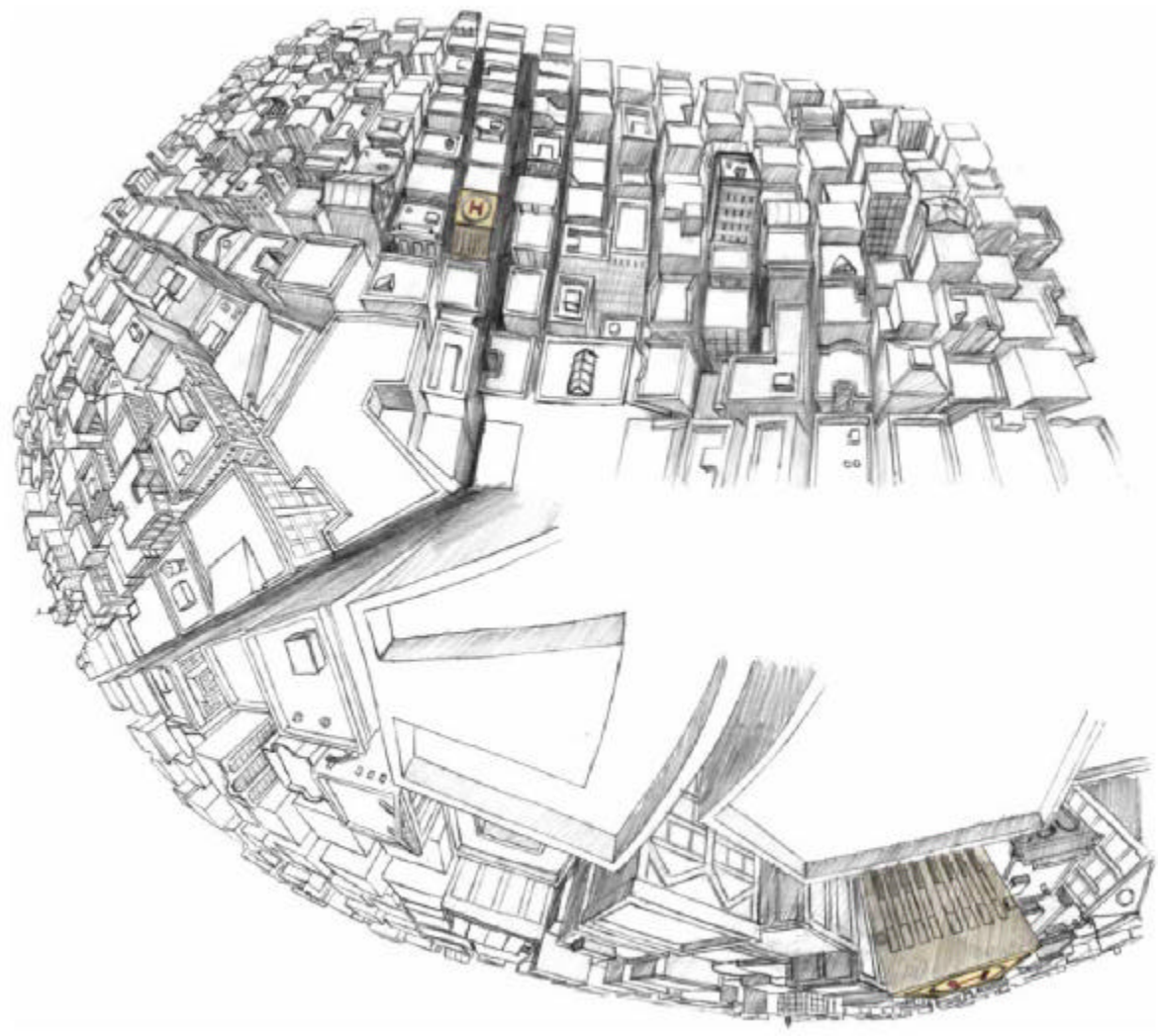
Multiperspective panorama

- [Wood et al. 98]



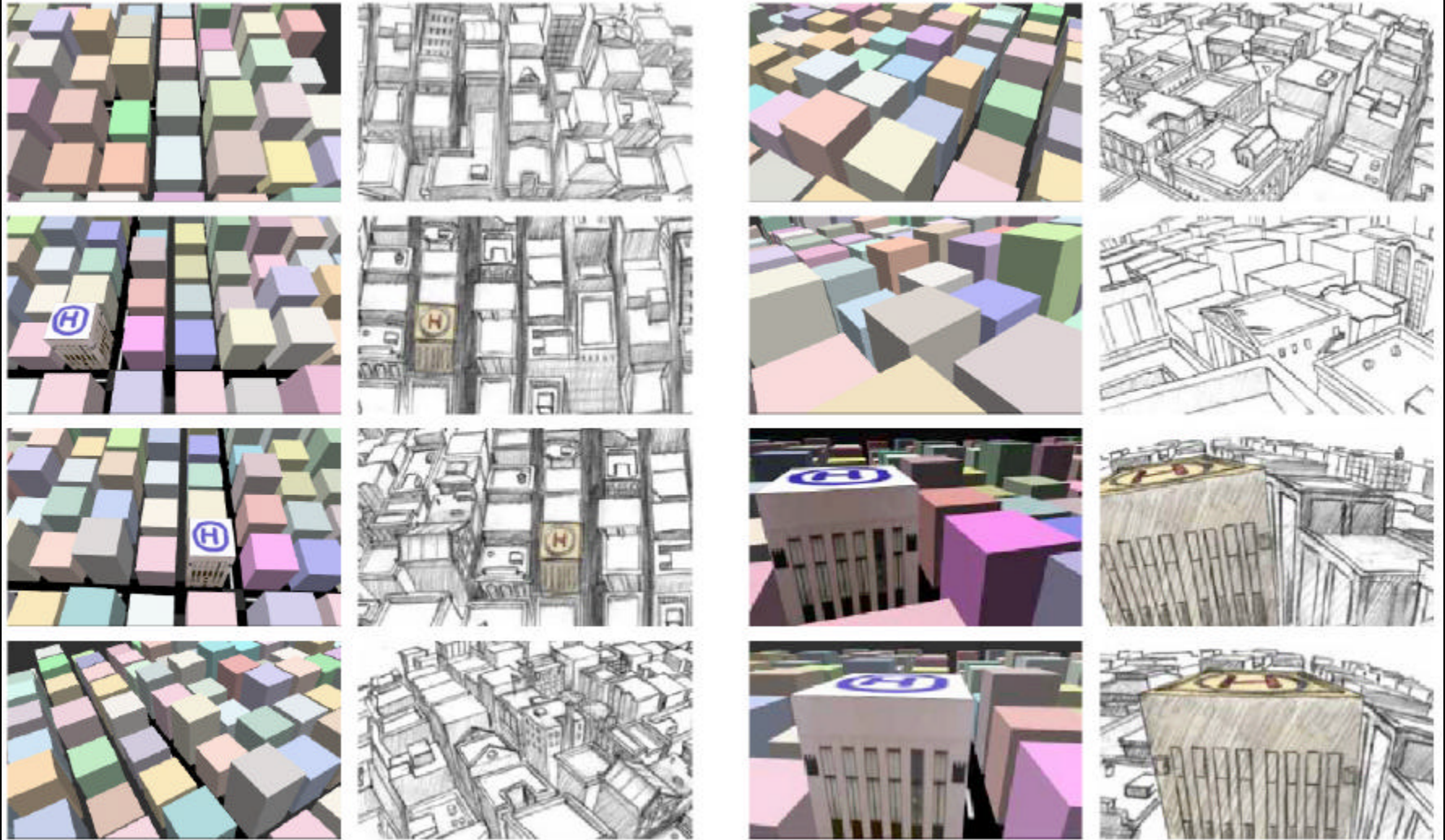
Multiperspective panorama

- [Wood et al. 98]



Multiperspective panorama

- [Wood et al. 98]



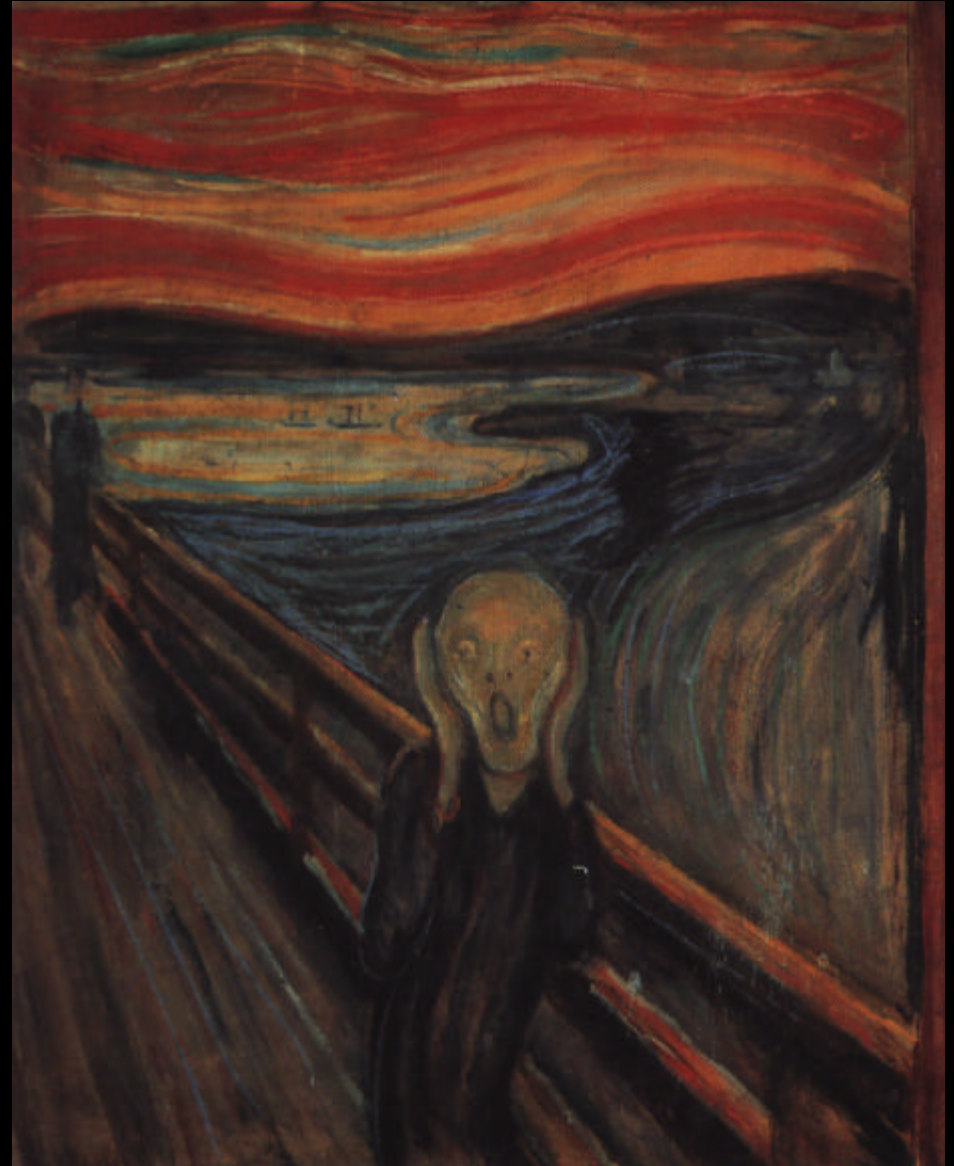
“Impressionist” perspective

- Pissarro



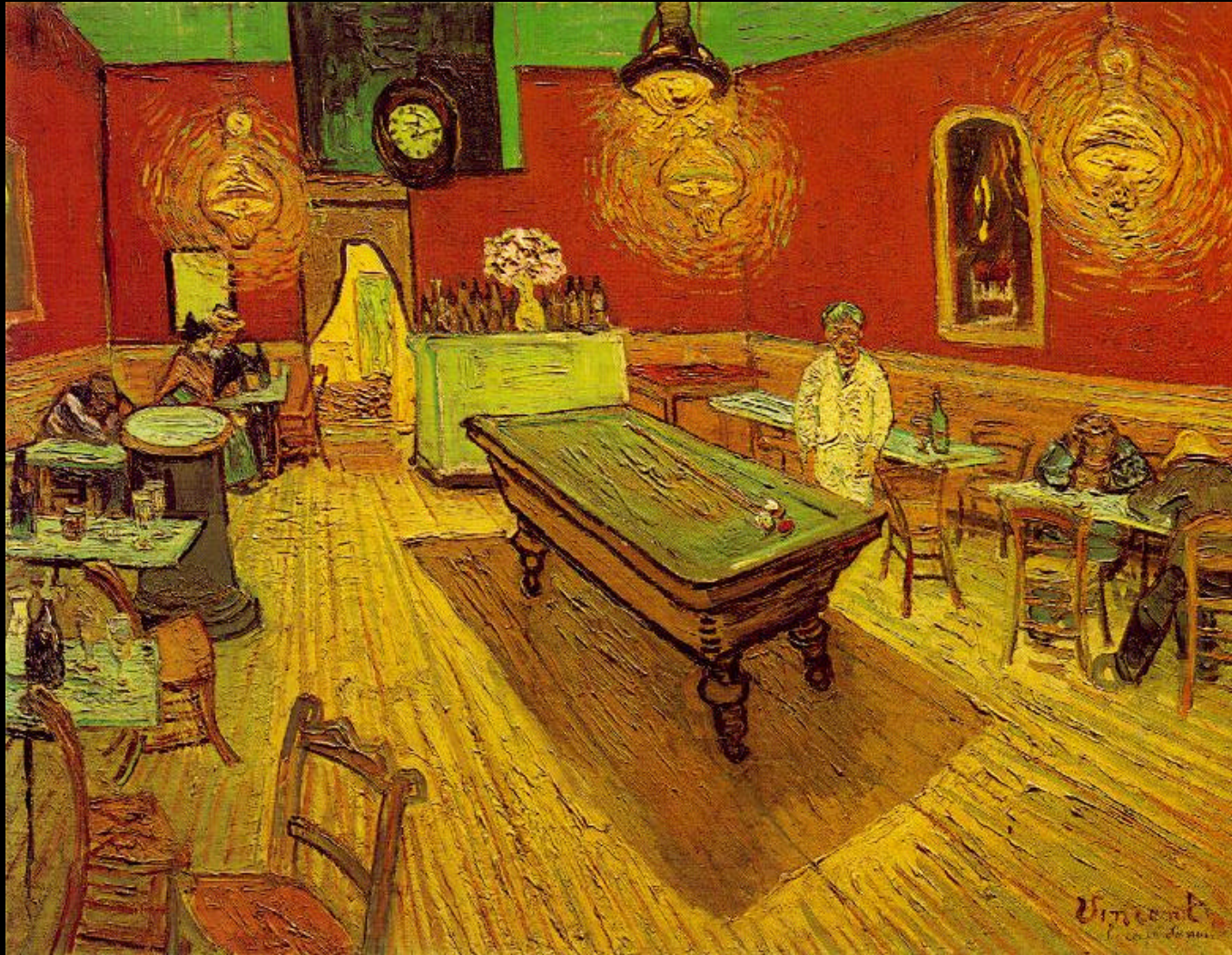
“Expressionist” perspective

- Munch,
the Scream



“Expressionist” perspective

- Van Gogh



Cézanne

- *Still life with basket, composition rule*



Cézanne

- *Montagne Ste Victoire*



Cézanne

- *Montagne Ste Victoire*



“Expressionist” perspective

- Max Beckman *Family Picture* 1920



“Expressionist” perspective

- Umberto Boccioni
The Street Enters The House
1911



Quasi linear

- Modigliani
Femme au Chapeau

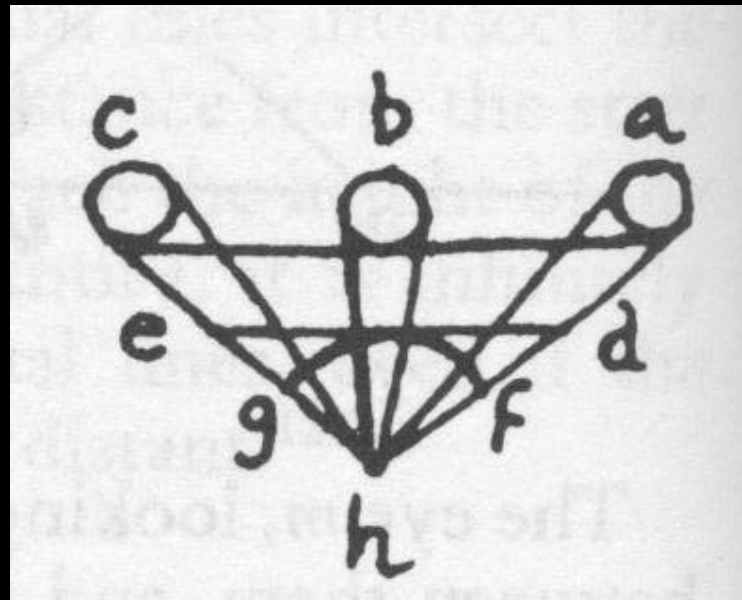
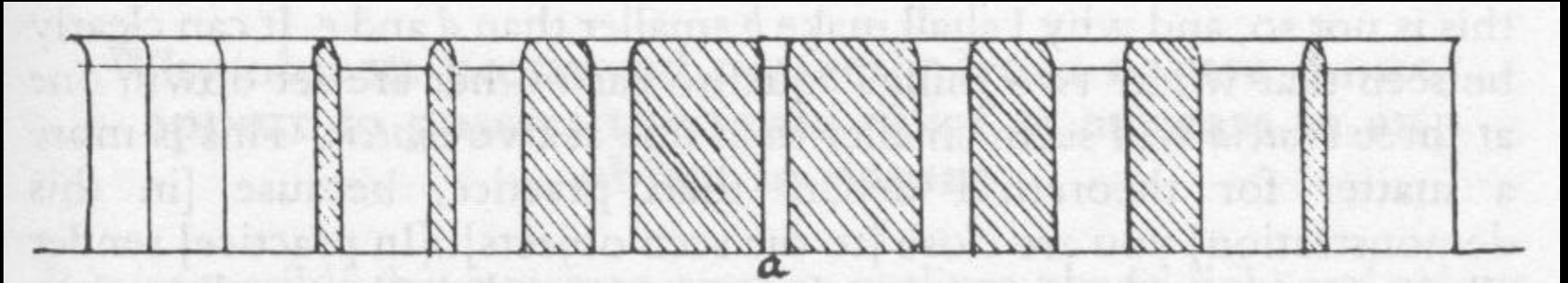


Classification of drawing systems

- Linear
 - Parallel
 - Linear perspective
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 - Curved projections
 - Topological
 - Split views, fold-out
 - Multiple viewpoints

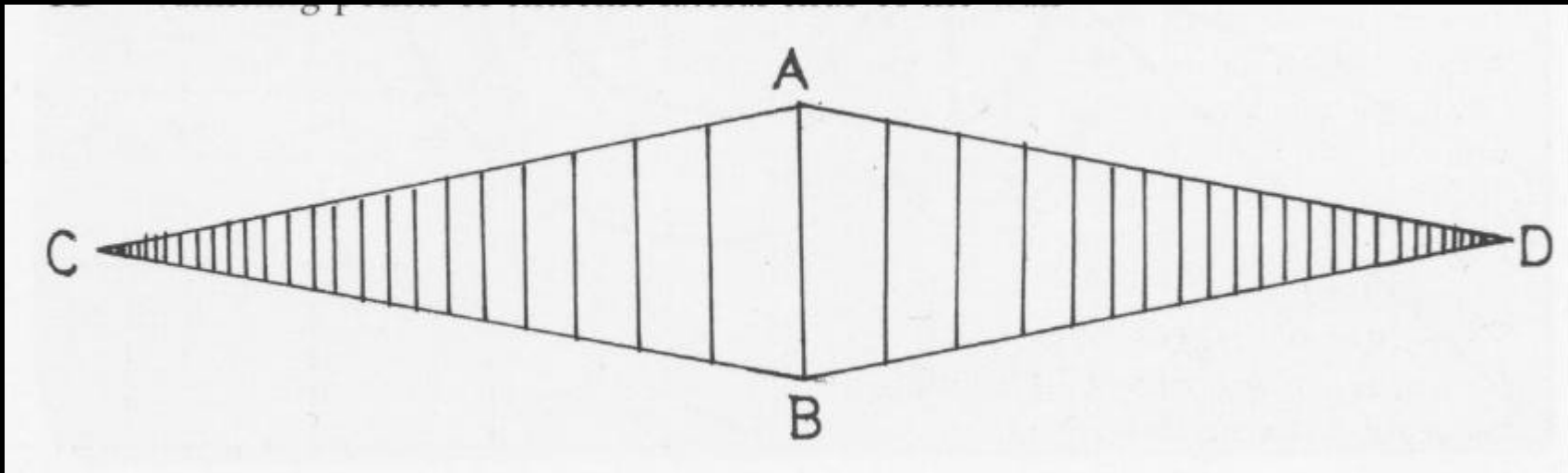
Leonardo & contradictions

- Wide angle vision



Leonardo & contradictions

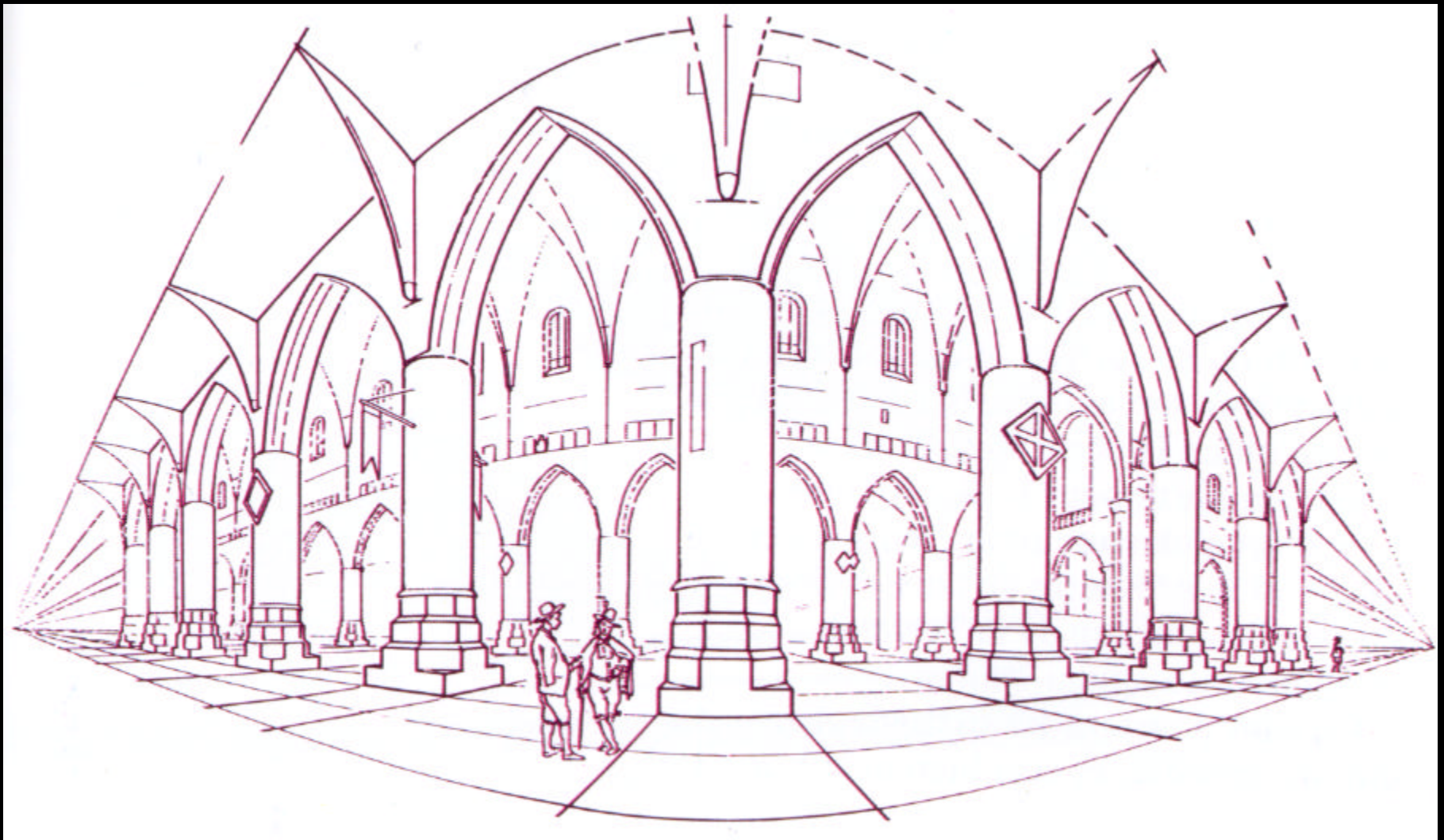
- Wide angle vision
- Lateral recession



Curved perspective

- Panorama
 - Preserve verticals
- Fish eye

Curved perspective



Curved perspective

- Jean Fouquet, 15th century



Curved perspective

- A View of Delft Carel Fabritius (follower of Rembrandt) 1652



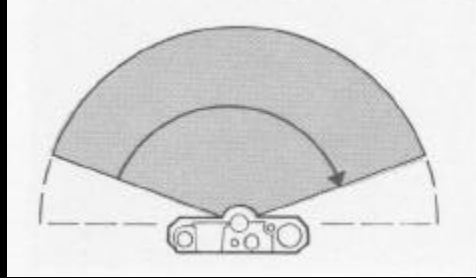
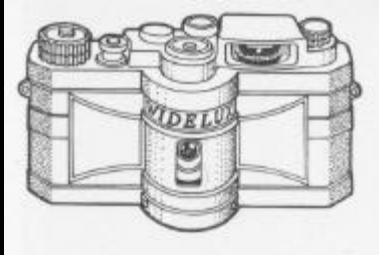
Curved perspective

- Turner *Petworth Park Tillington, Church in the Distance* 1828



Curved perspective

- Panoramic camera



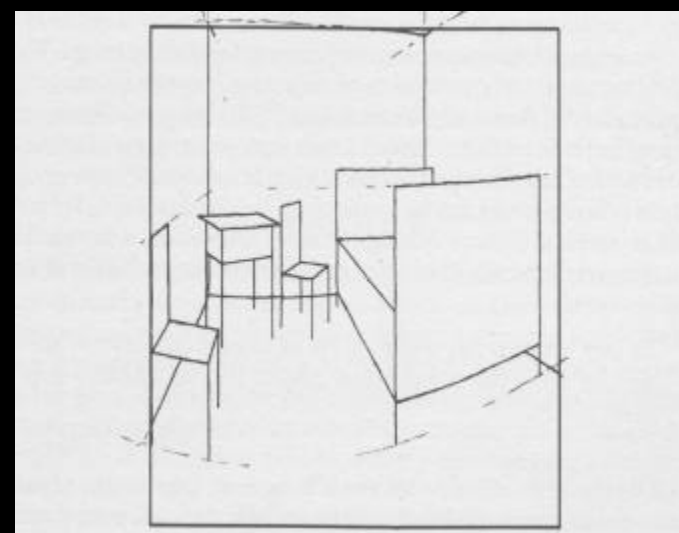
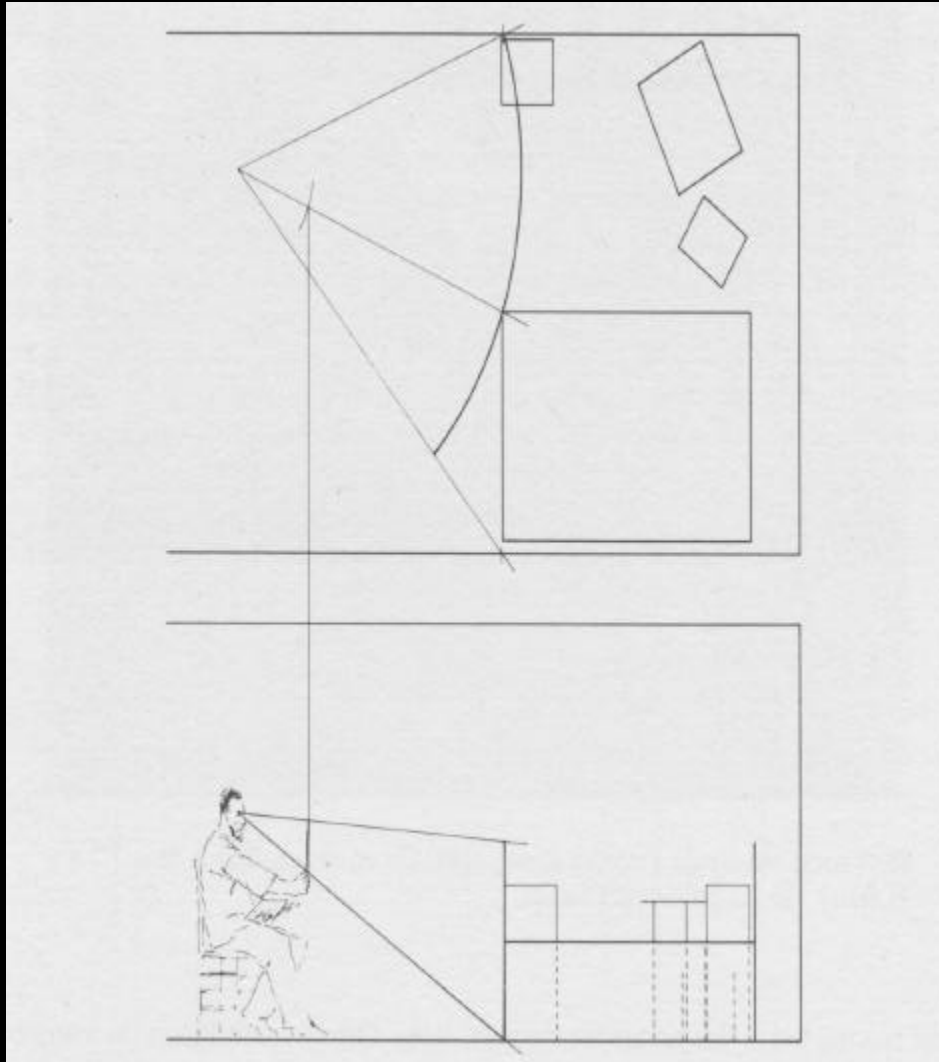
“Expressionist” perspective

- Van Gogh, *Bedroom in Arles*



“Expressionist” perspective

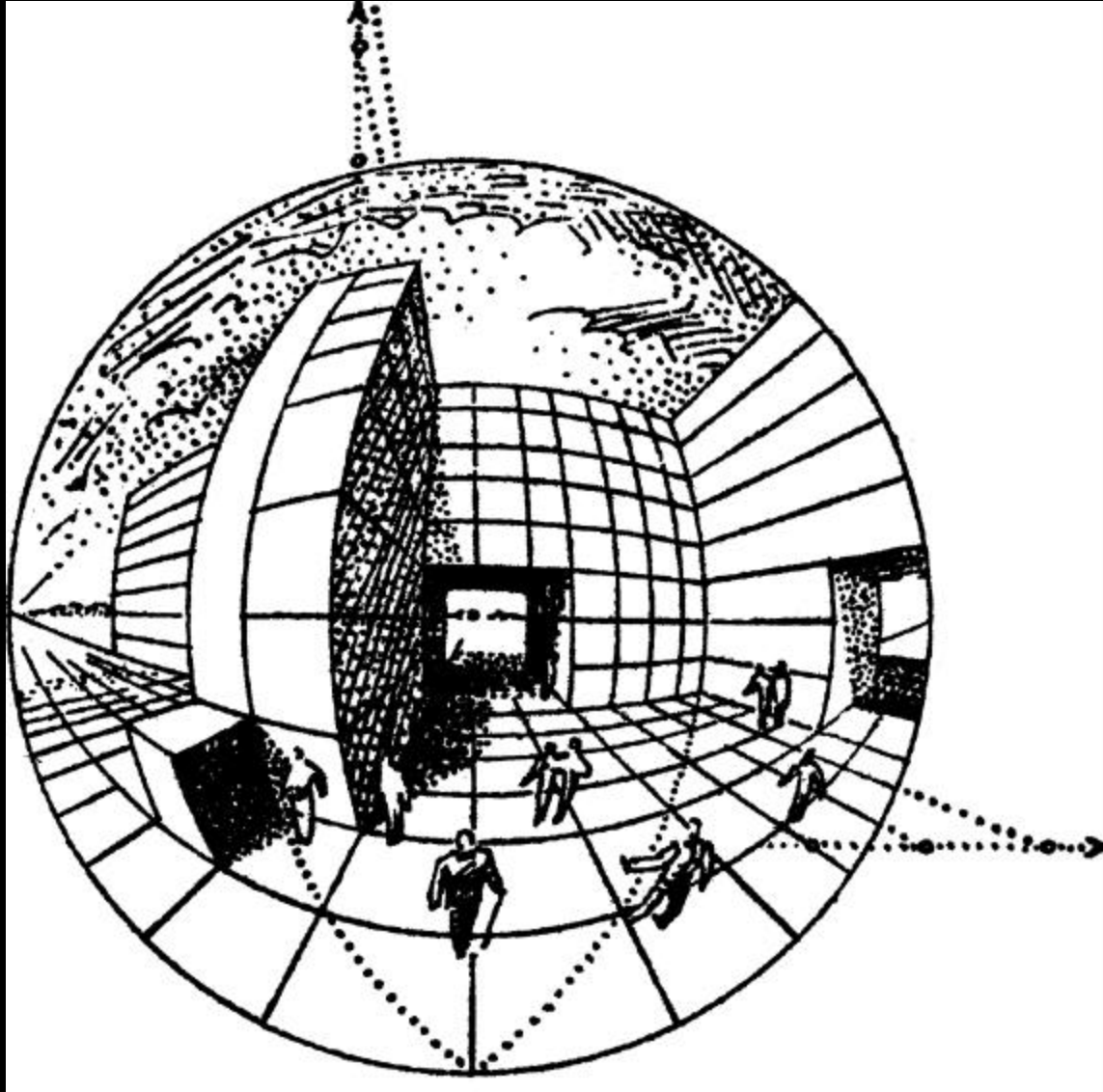
- Van Gogh, *Bedroom in Arles*



Curved perspective

- Panorama
 - Preserve verticals
- Fish eye

Fish-eye

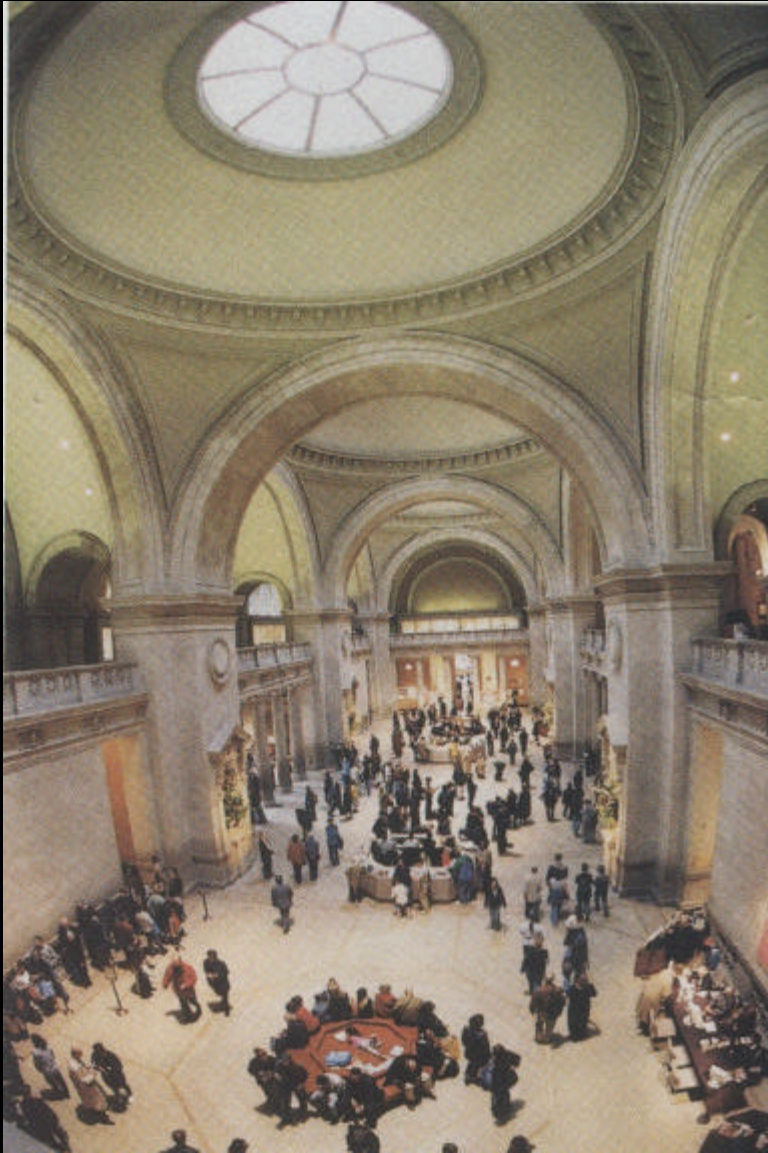


Fish-eye vs. wide angle



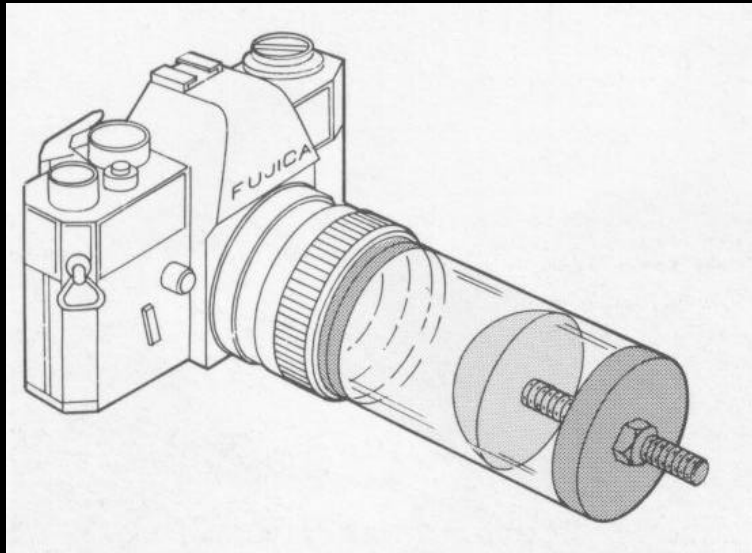
Drawing systems

Fish-eye vs. wide angle



Drawing systems

Bird's eye attachment

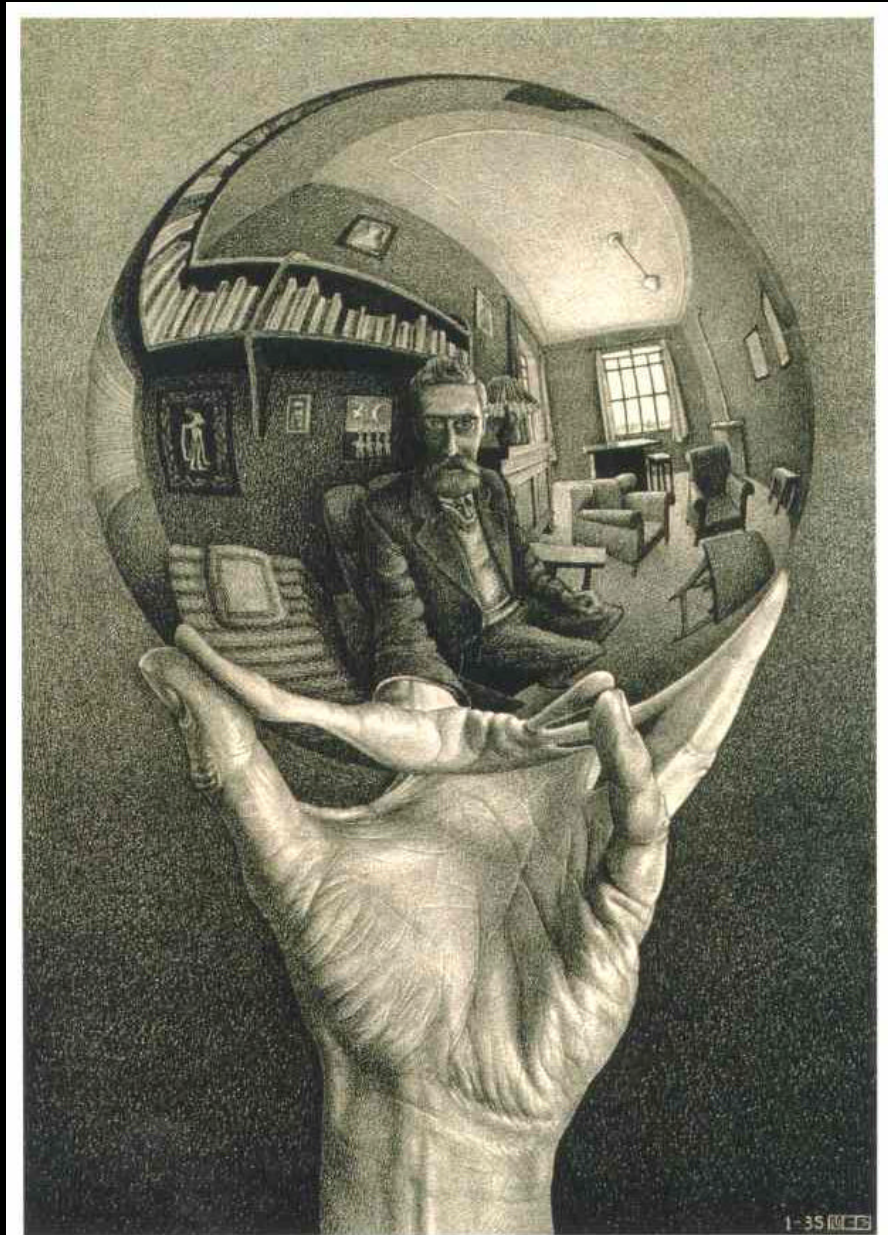


Fish-eye



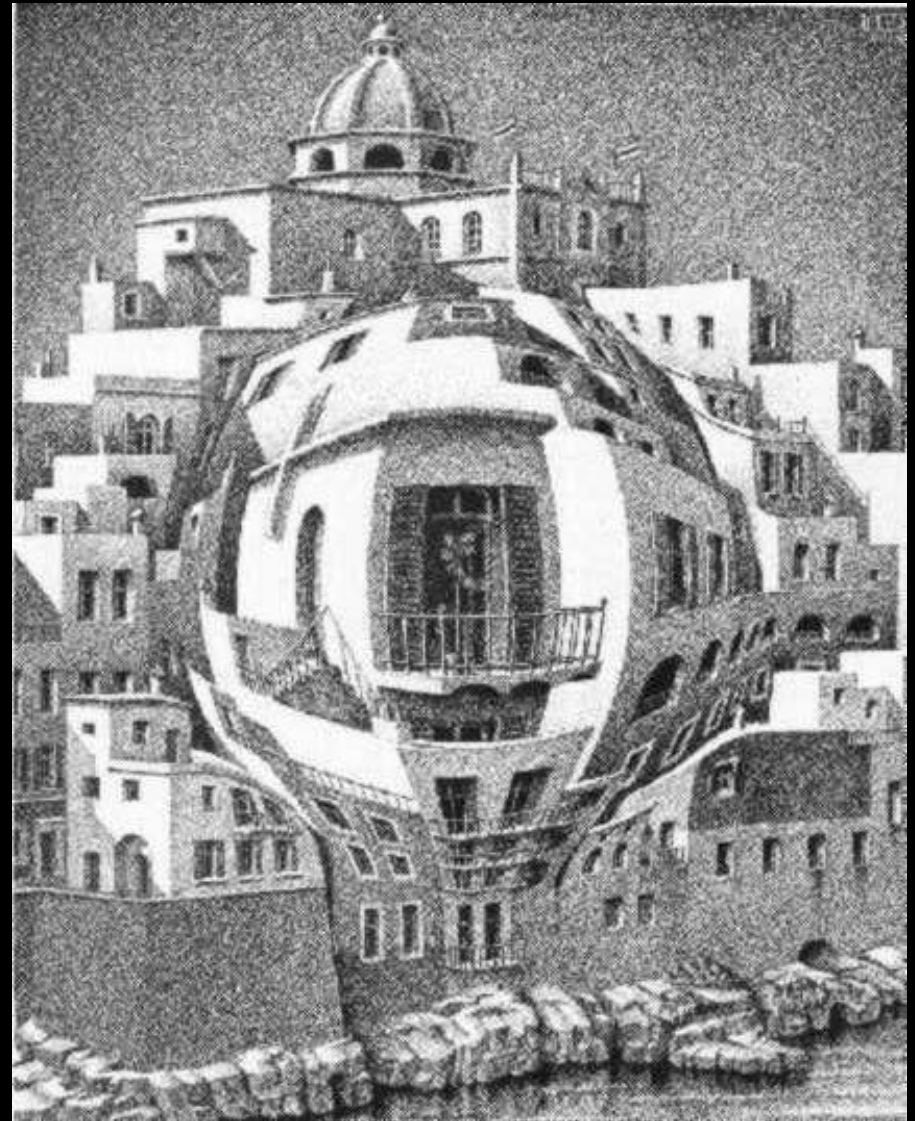
Fish-eye

- MC Escher, *Hand with Reflecting Globe*



Fish-eye

- MC Escher, *Balcony*



Fish-eye

- *London from St Paul's cathedral 1845*



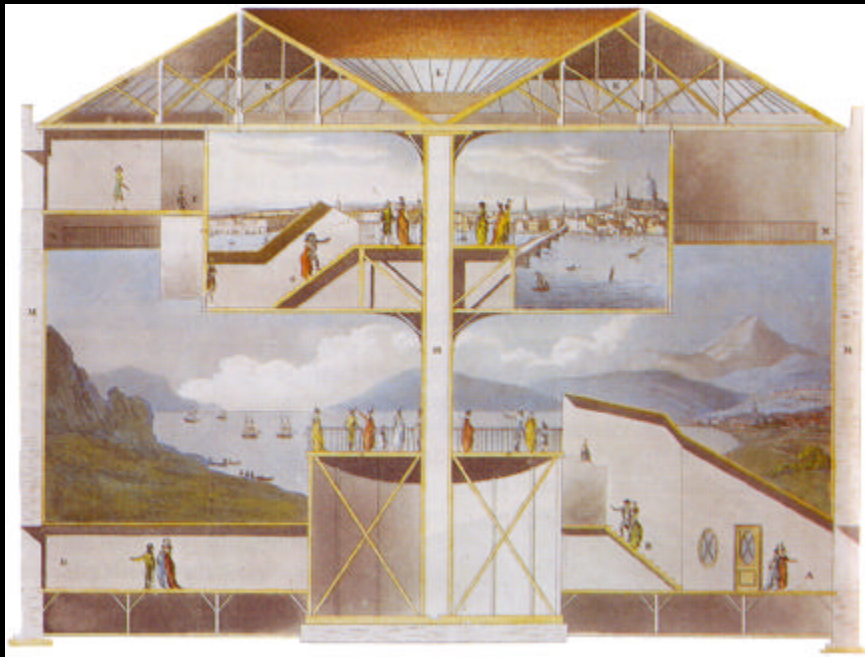
Fish-eye

- Anthony Green The 30th Wedding Anniversary



Projection surface

- Panorama, Imax
- “Good viewpoint”
 - Primary geometry and viewing conditions match



Projection

- Pavilion in the Colosseum
Regent's Park
1829

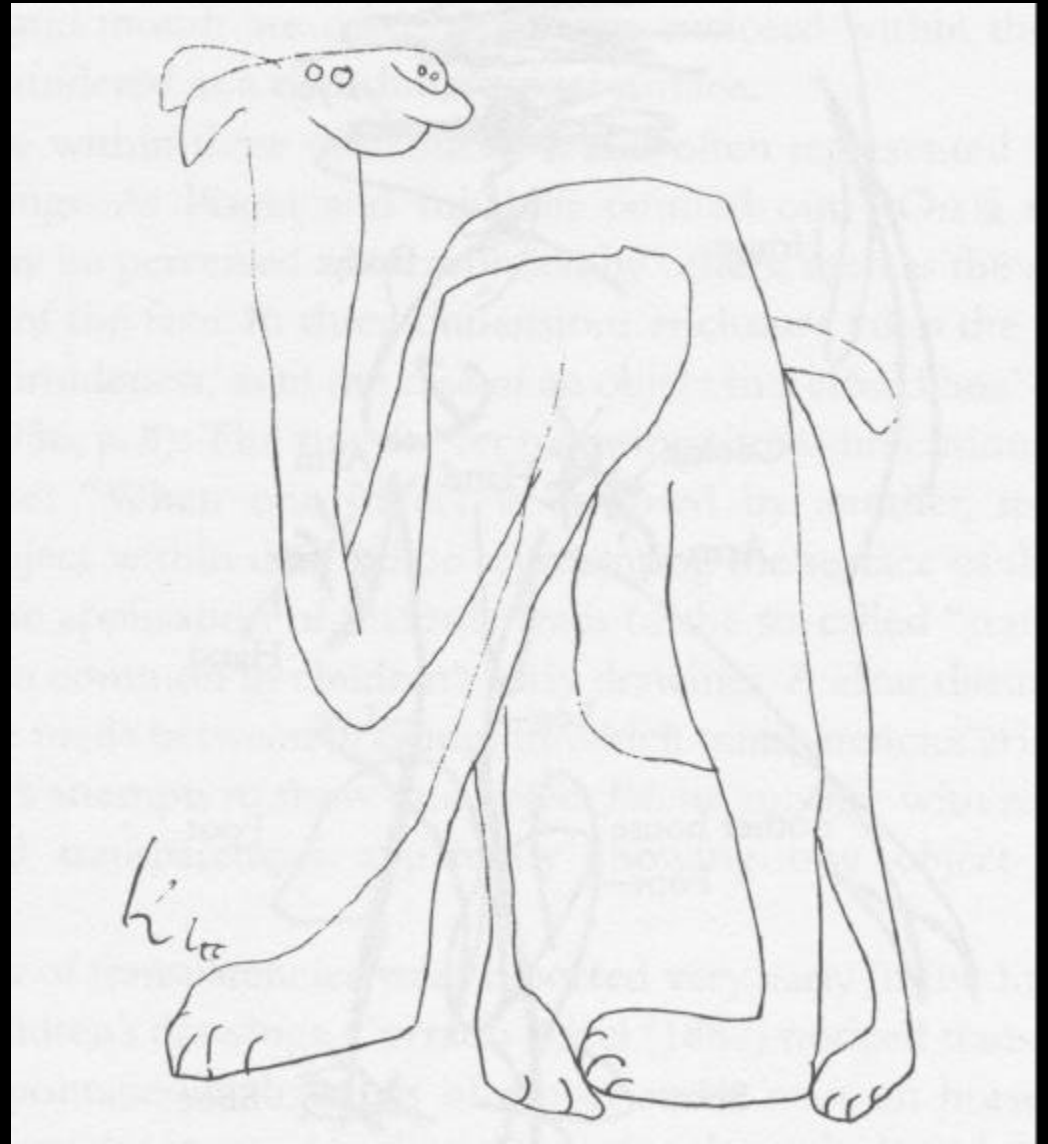


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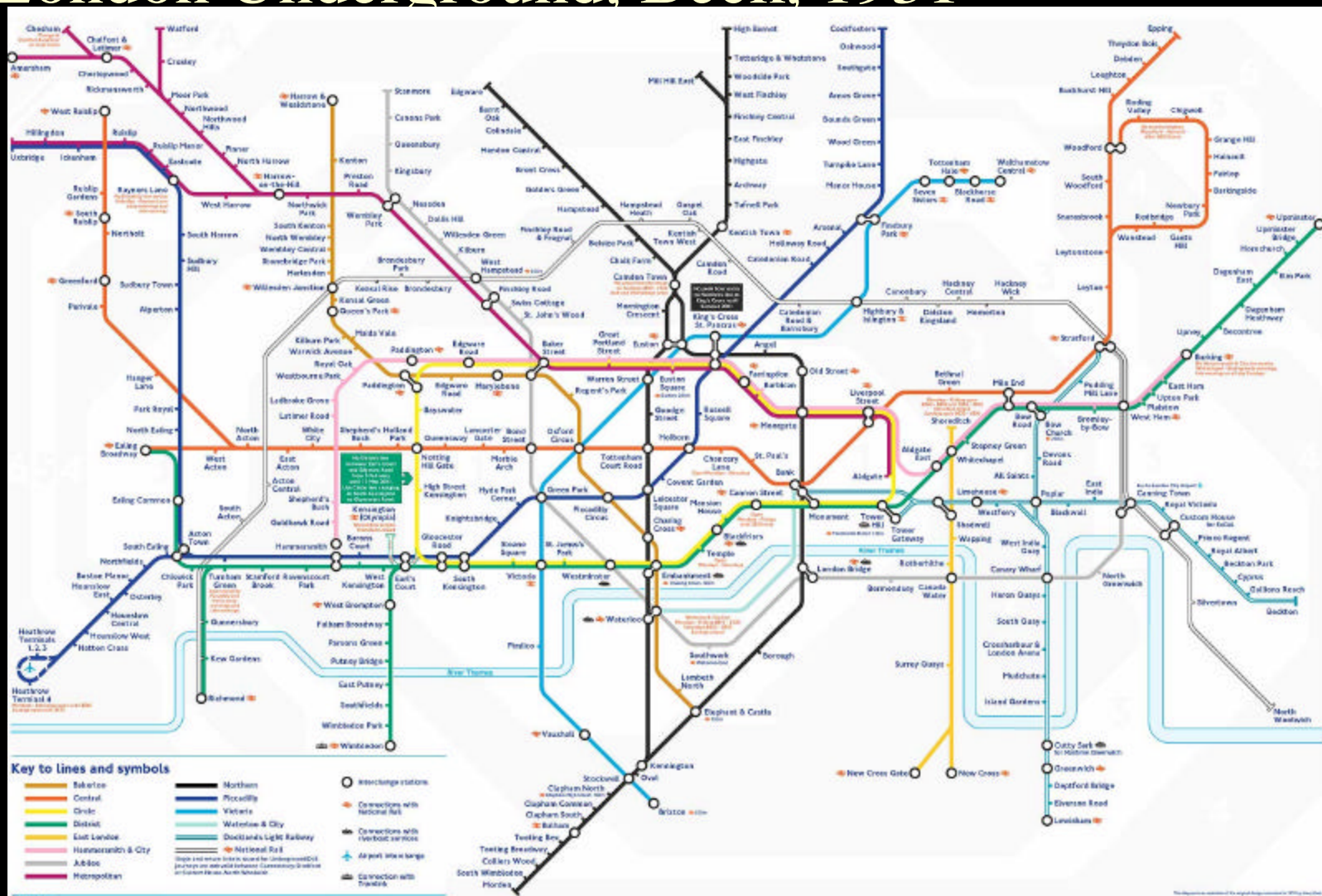
Topological

- Paul Klee,
Another Camel



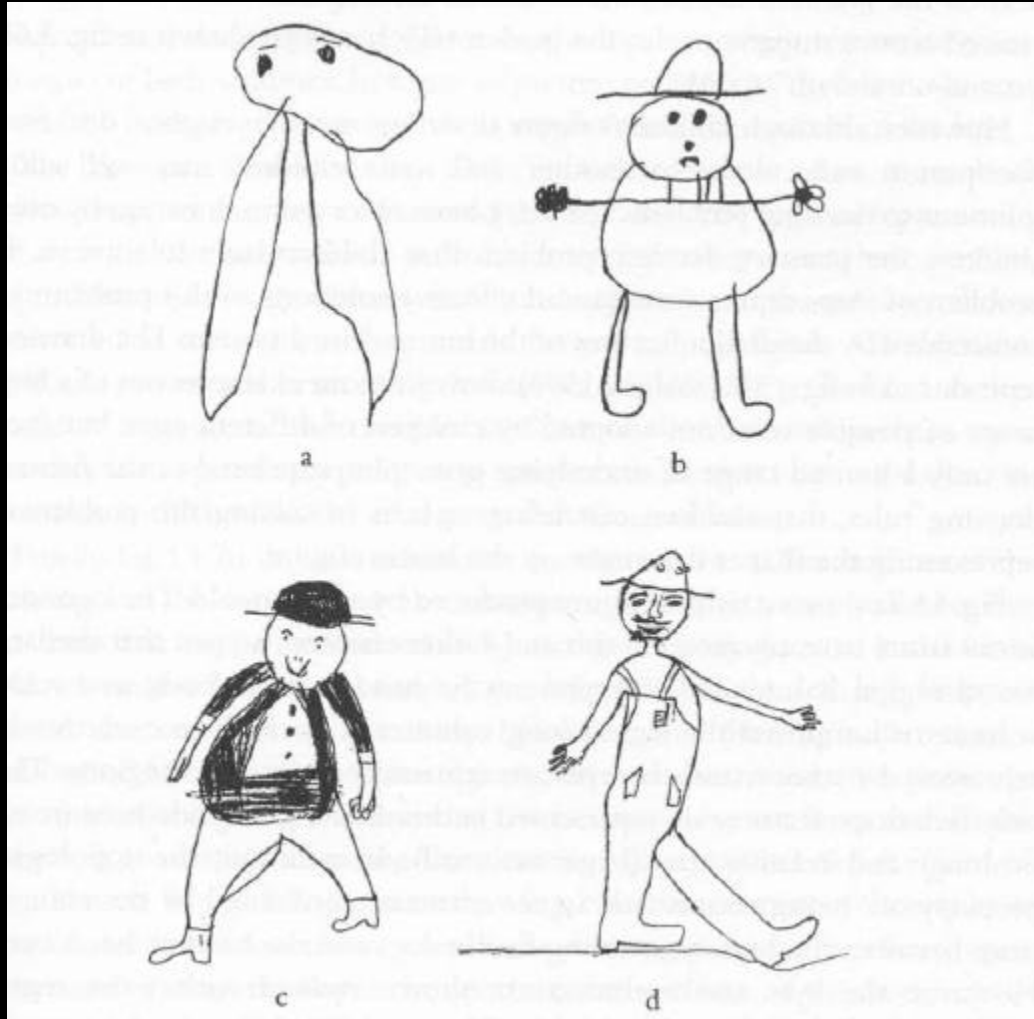
Topological

- London Underground, Beck, 1931



Topological

- Children drawing



Topological

- Comics

calvin and HOBBS

BY WATKINS



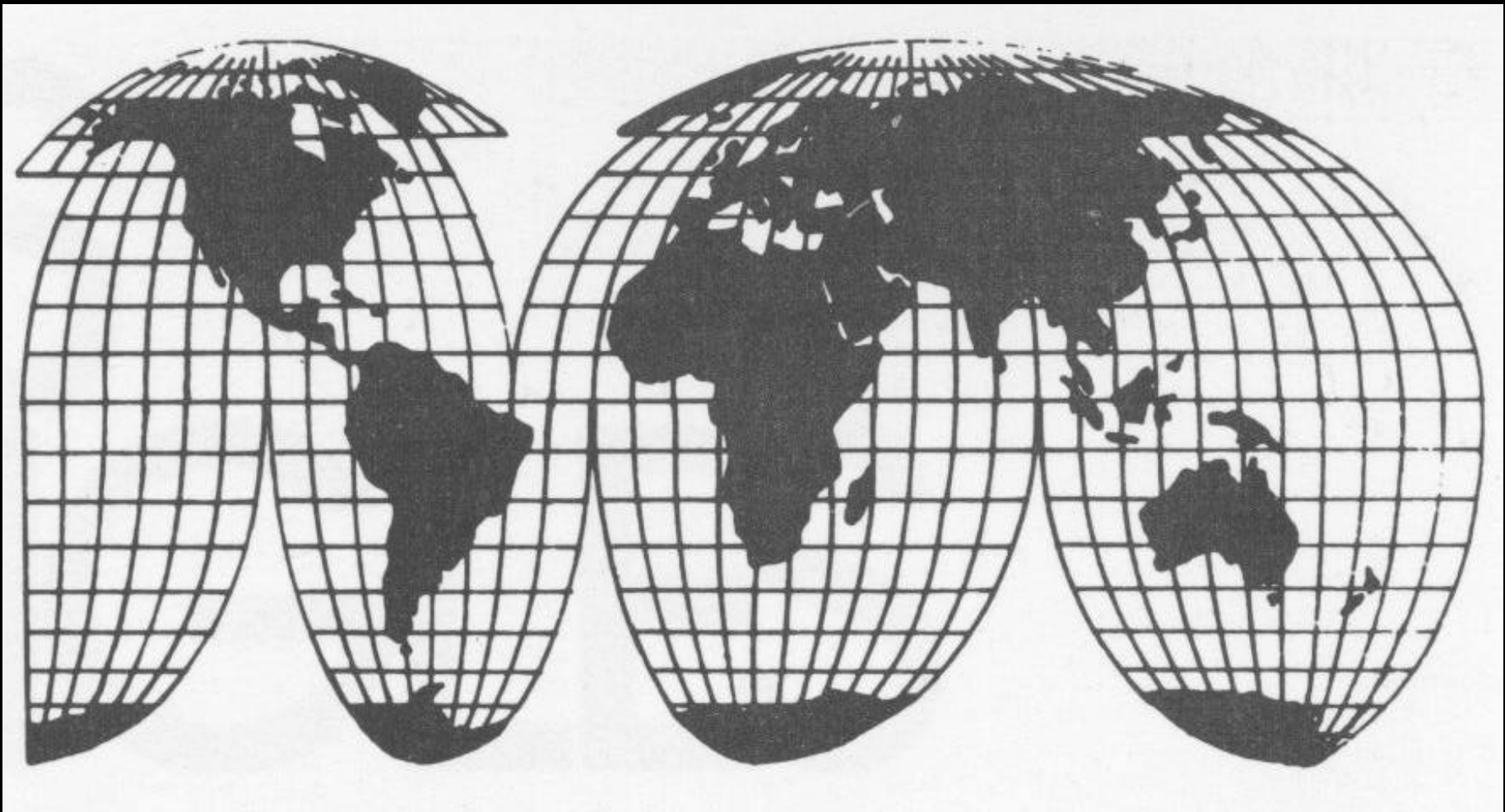
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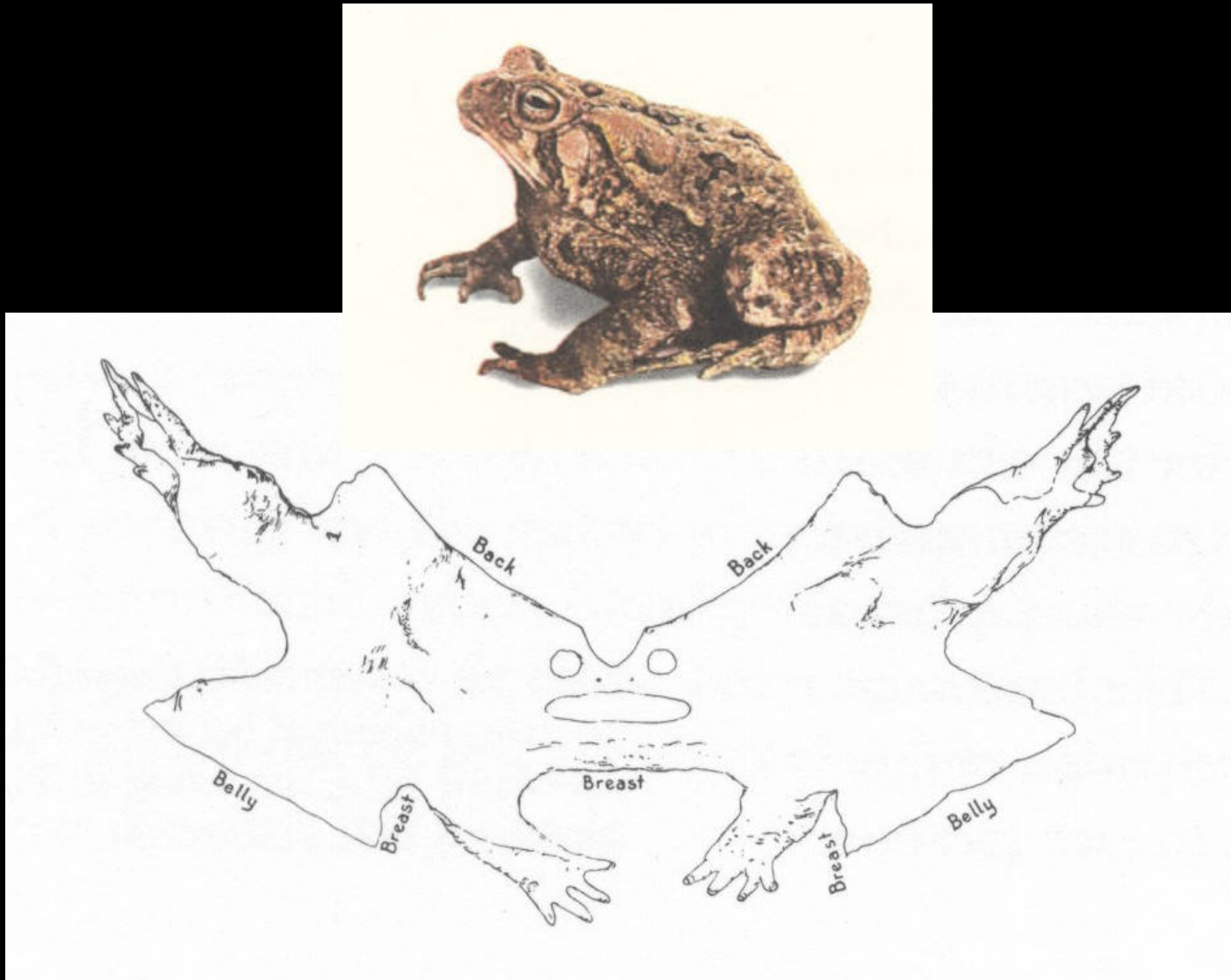
Split views, fold-out

- Can be seen as a smooth viewpoint change
- Can represent an object from all sides
- Continuity, preserves topology

Split views, fold-out



Split views, fold-out



Split views, fold-out

- Picasso,
Portrait of a woman



Split views, fold-out

- Northwest Indian
Double Profile Bear



Split views, fold-out



Split views, fold-out

- Multiple-center of projection images, Paul Rademacher



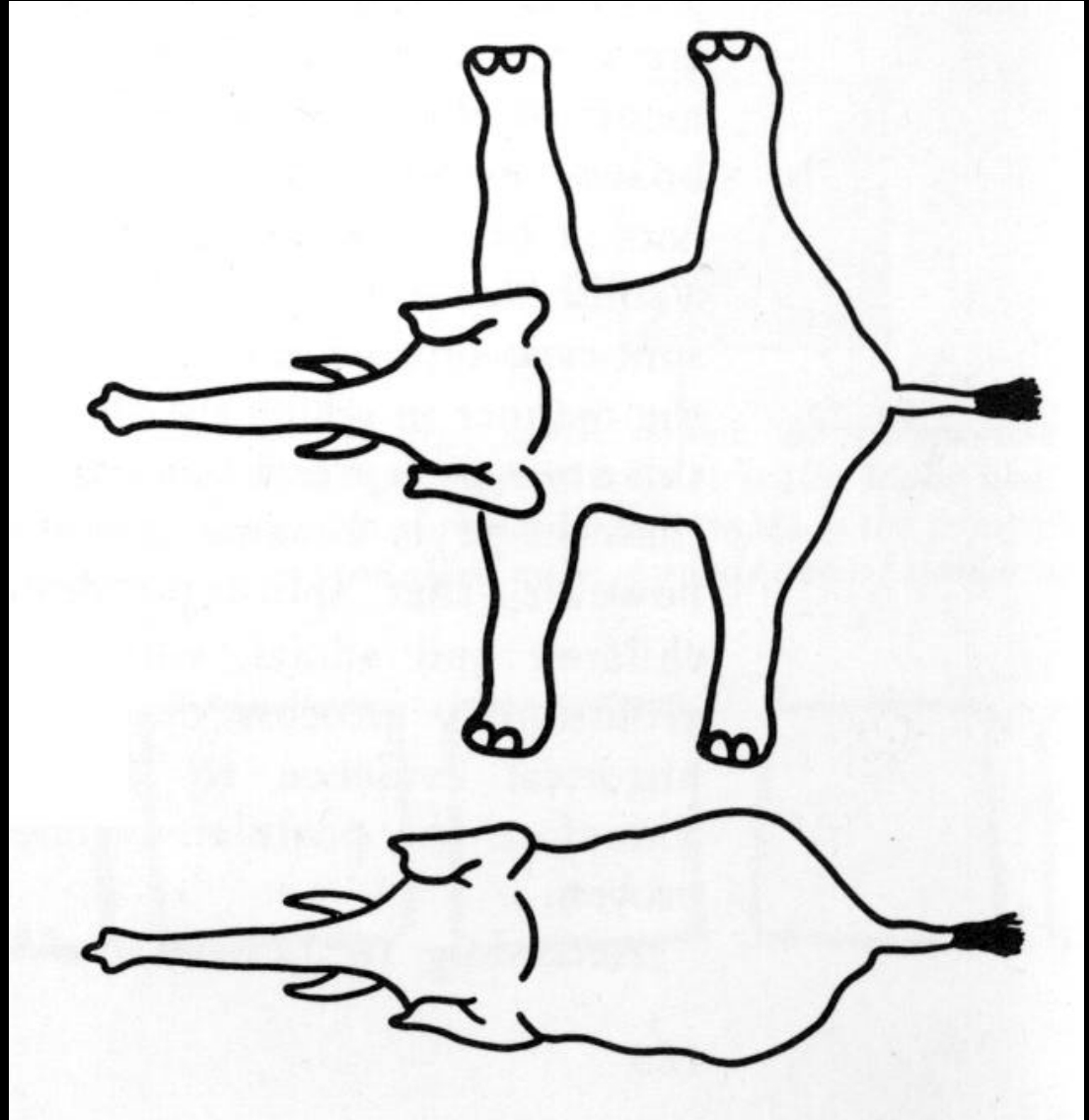
Split views, fold-out

- Multiple-center of projection images, Paul Rademacher



Split views, fold-out

- Multicultural study



Split views, fold-out

- Interactive caricature (Fred Vernier)



Split views, fold-out

- Interactive caricature (Fred Vernier)



Split views, fold-out

- Interactive caricature (Fred Vernier)



Split views, fold-out

- Interactive caricature (Fred Vernier)



Cinema

- Robert Wiene The cabinet of Dr Caligari 1919-1920



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Multiple viewpoints

- No more unity of pictorial space
- Represents objects from different viewpoints
- Less continuity, no topology

Cubism

- *Candlestick*
George Braque
1911



Cubism

- *Boats*
George Braque



Hockney

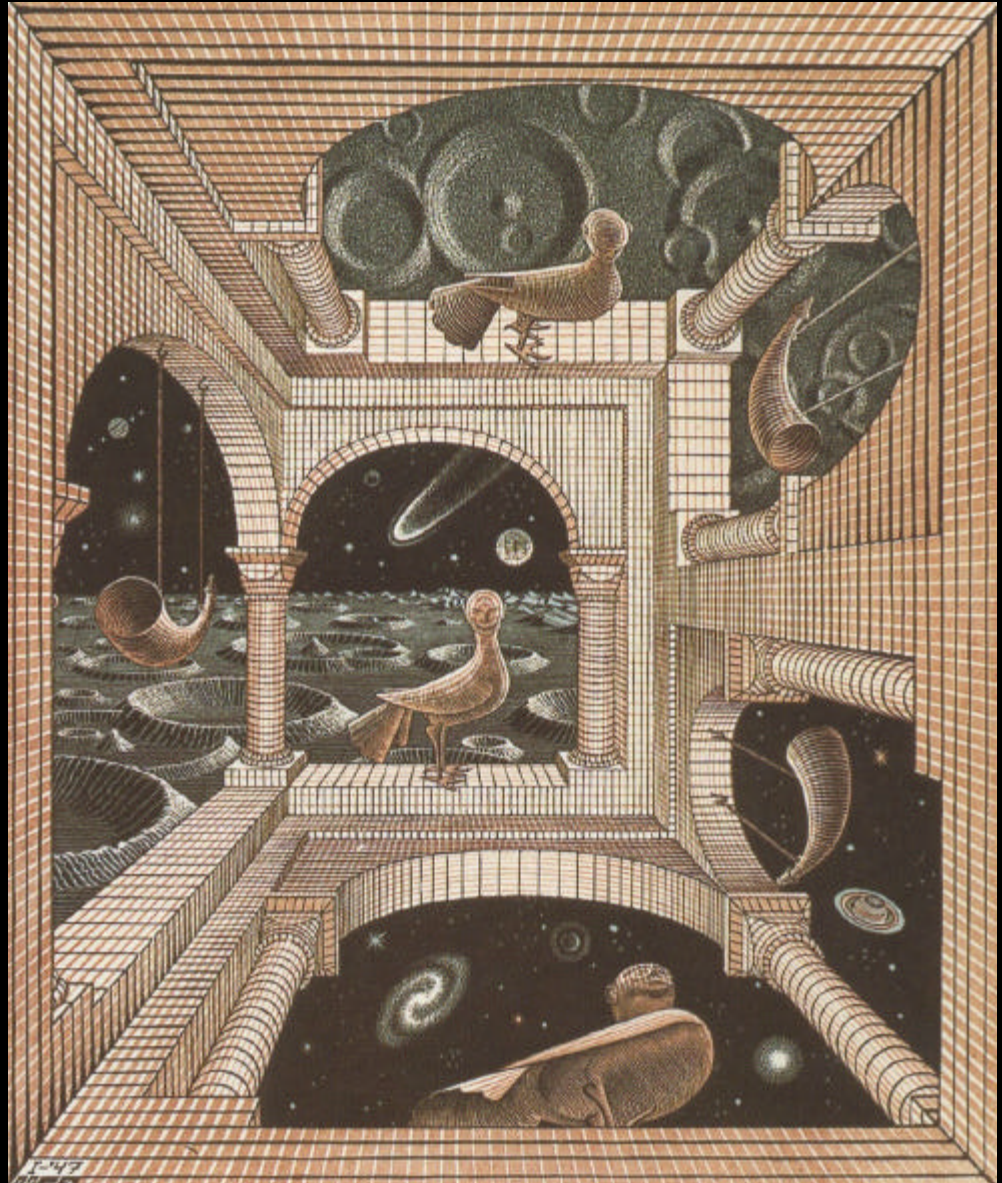


Hockney



Escher

- *Other World* 1947



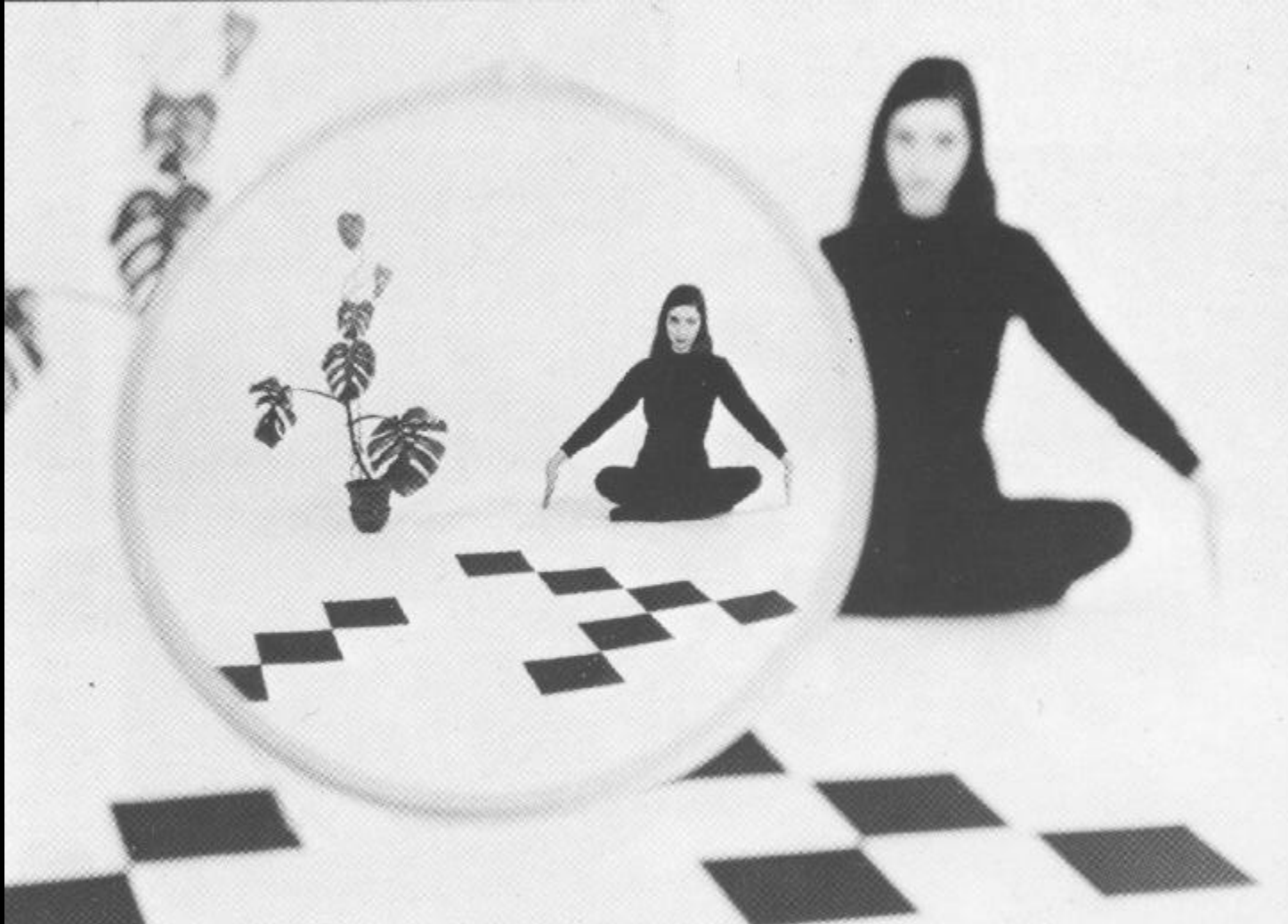
Mirrors, lenses

- Freddie Francis
The Skull



Mirrors, lenses

- *Hedgecoe*



Mirrors, lenses

- Casas Abarca
Le Salon
1875-1958



Mirrors, lenses

- Manet, Le Bar Des Folies Bergeres



Discussion

- No universal solution
- Secondary geometry
- Invariants
- Property mapping or translation

Drawing and cinema

- Characters too close
- Trenching
- Etc.