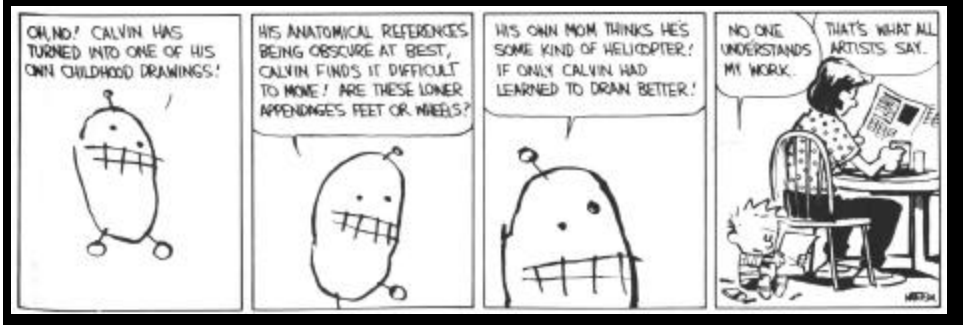
The Art and Science of Depiction

Non-linear Drawing systems

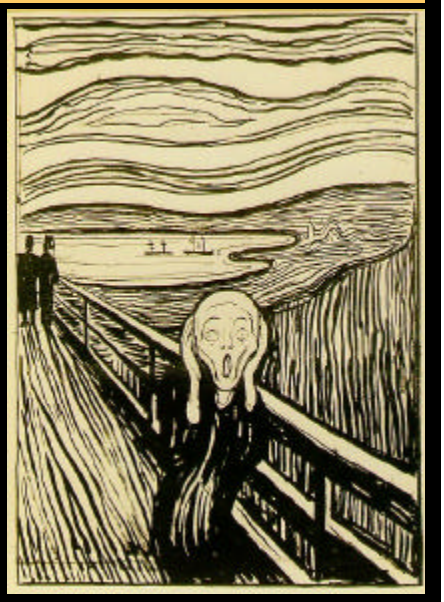
Fredo Durand
MIT- Lab for Computer Science

Non-linear drawing systems

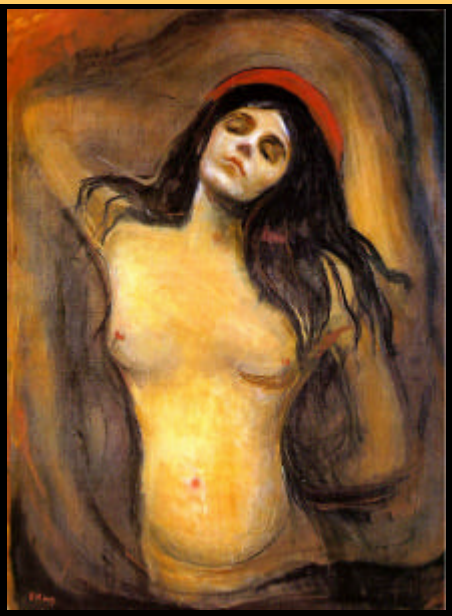


Munch exhibition

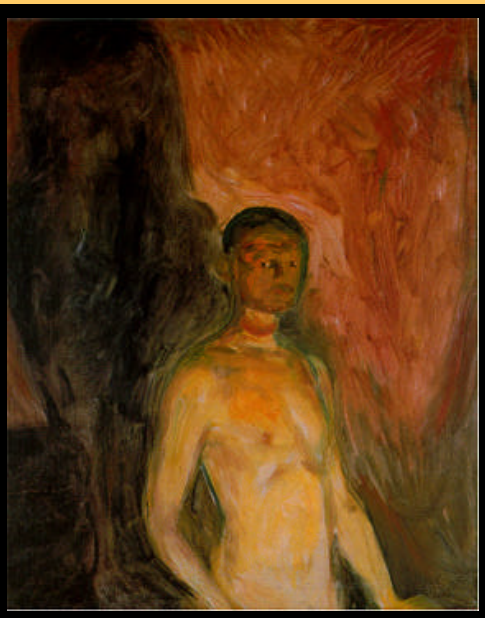
- Boston College
- Until May 21.
- Birth of expressionism



Munch



Munch



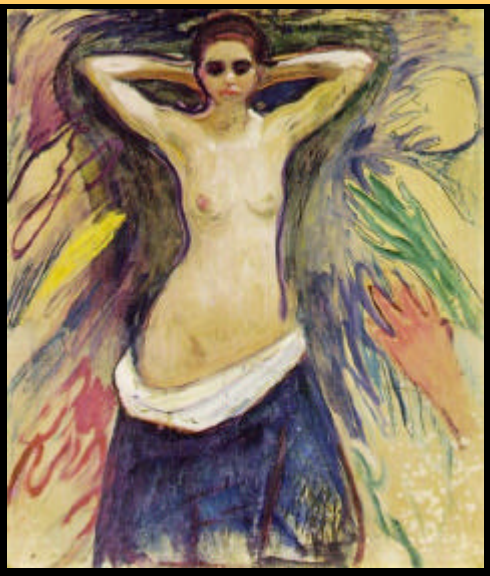
Munch

Munch

Munch

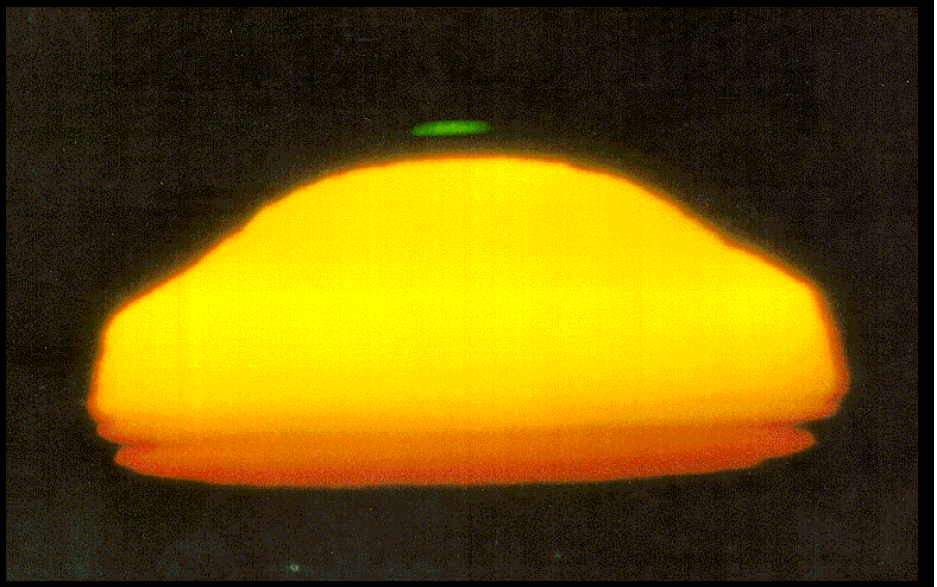
Munch

Munch

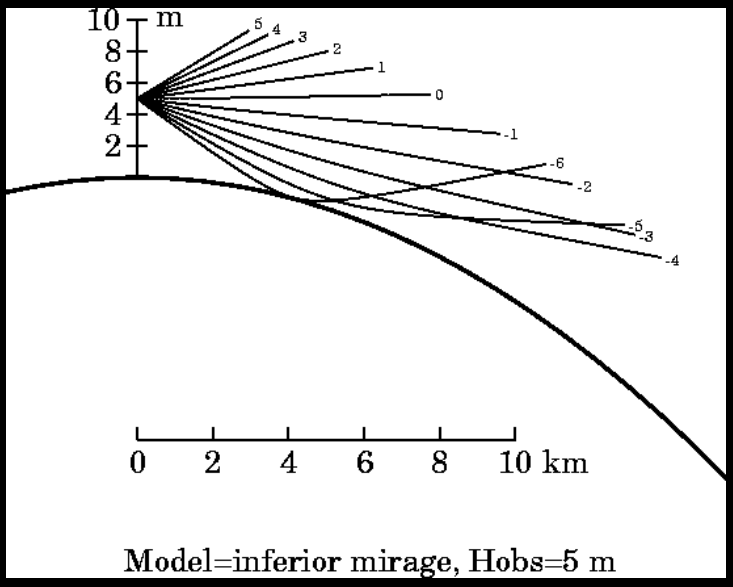


Green flash

Green flash



Green flash



Green flash

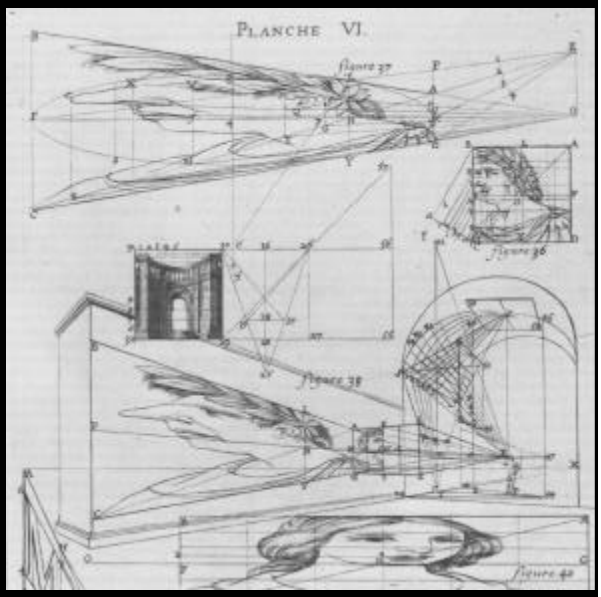
INFERIOR-MIRAGE
SUNSET
for
L = -10 m
seen from 4 m

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

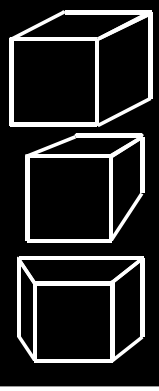
Classification of drawing systems

- 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

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  - Parallel
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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

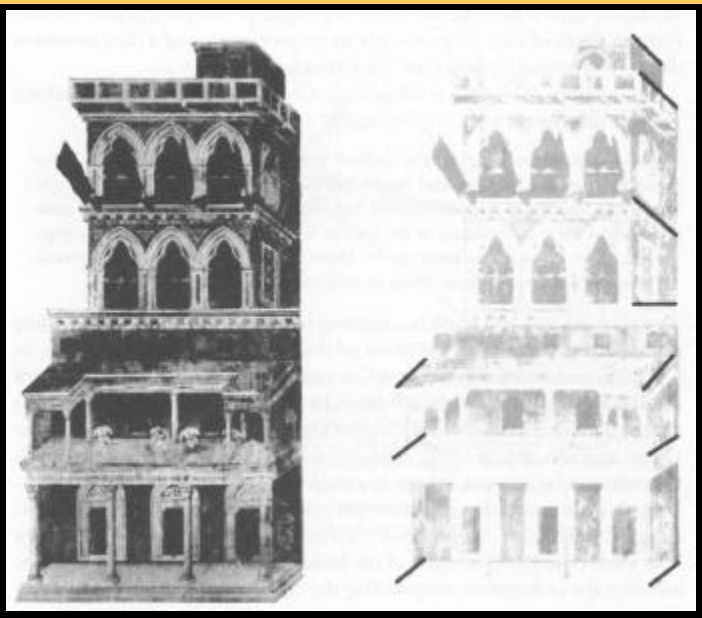
- Attempt to depict scene 3 dimensionally
- Often lack of skill
- More or less formal secondary geometry rules

Naïve perspective

- Pompeii

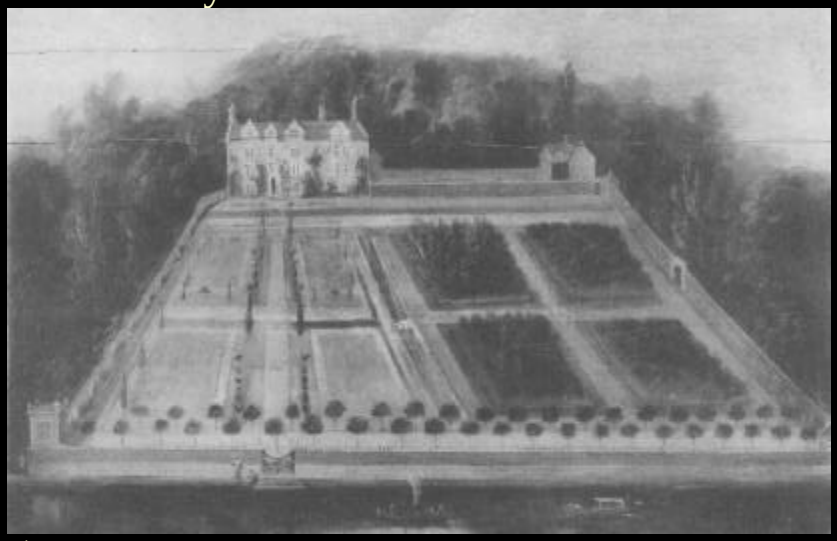
Naïve perspective

- Giotto



Naïve perspective

- 18th century



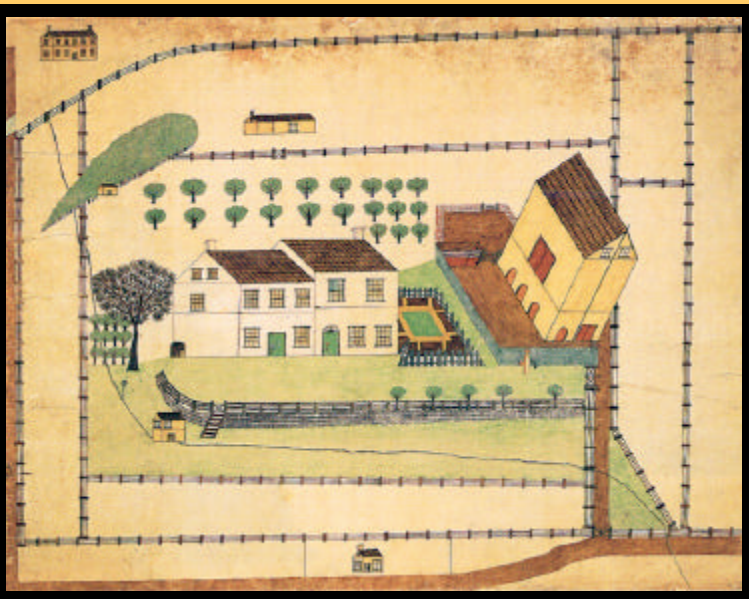
Locally linear

- 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



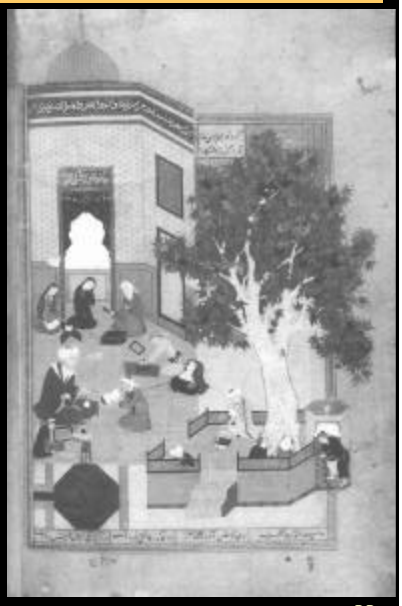
Locally linear

Locally linear

- Egyptian
- Best view for each object

Locally linear

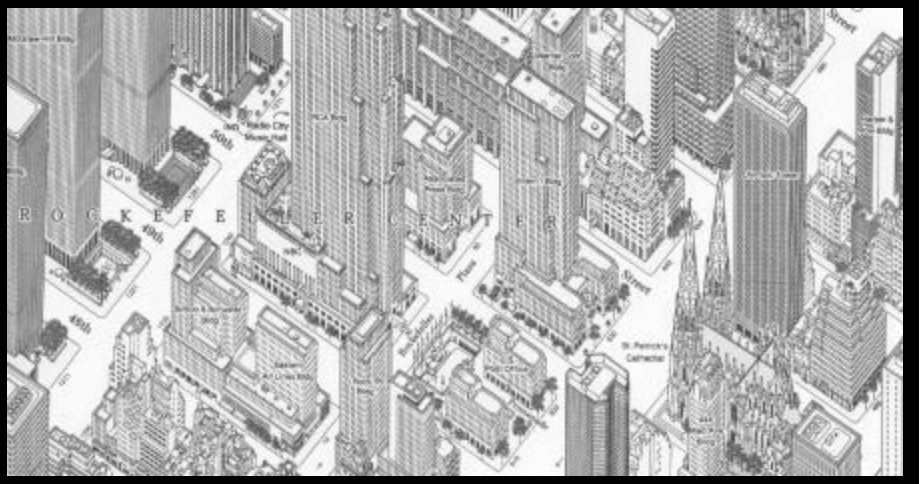
- Persian miniature, 1494
- Oblique+vertical oblique



Locally linear

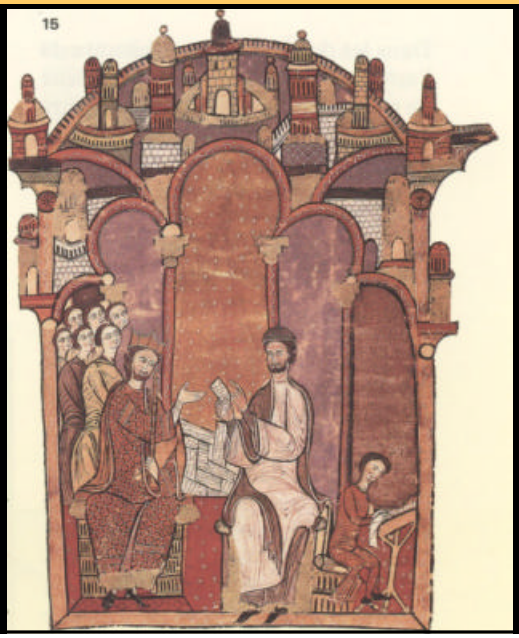
Locally linear

- 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

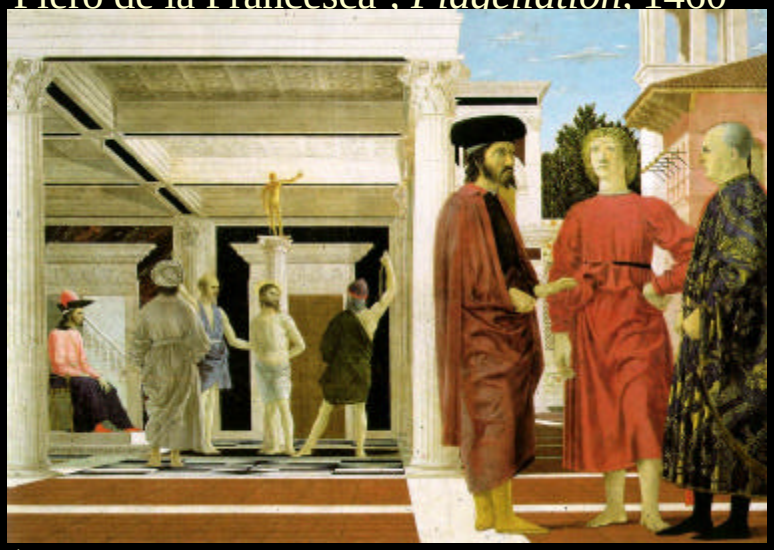
Importance-driven

Importance-driven

- Piero de la Francesca *Mercy*

Comparison

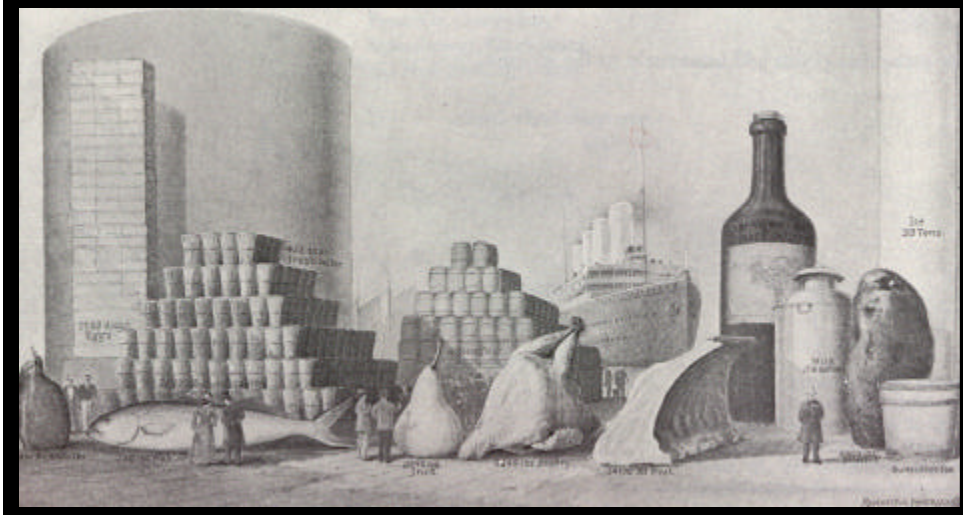
- Piero de la Francesca , *Flagellation*, 1460



Importance-driven

Data-driven

- Scientific American

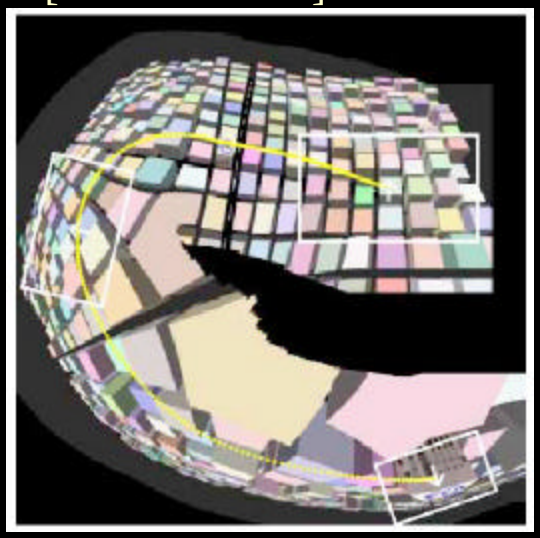


Cell multiperspective panorama

- Pinocchio, Walt Disney

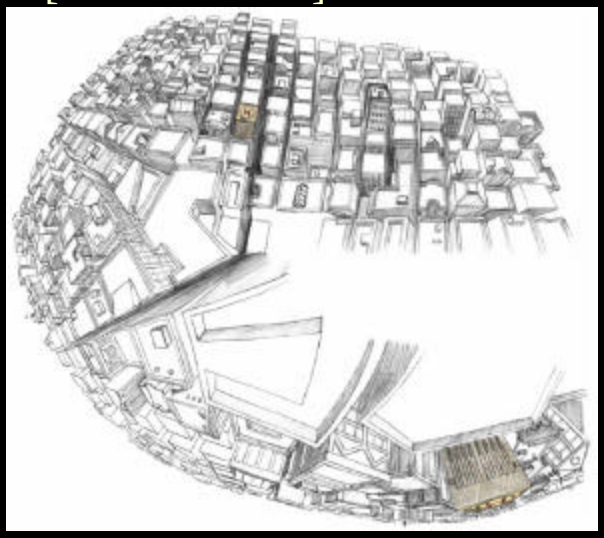
Multiperspective panorama

- [Wood et al. 98]



Multiperspective panorama

- [Wood et al. 98]



Multiperspective panorama

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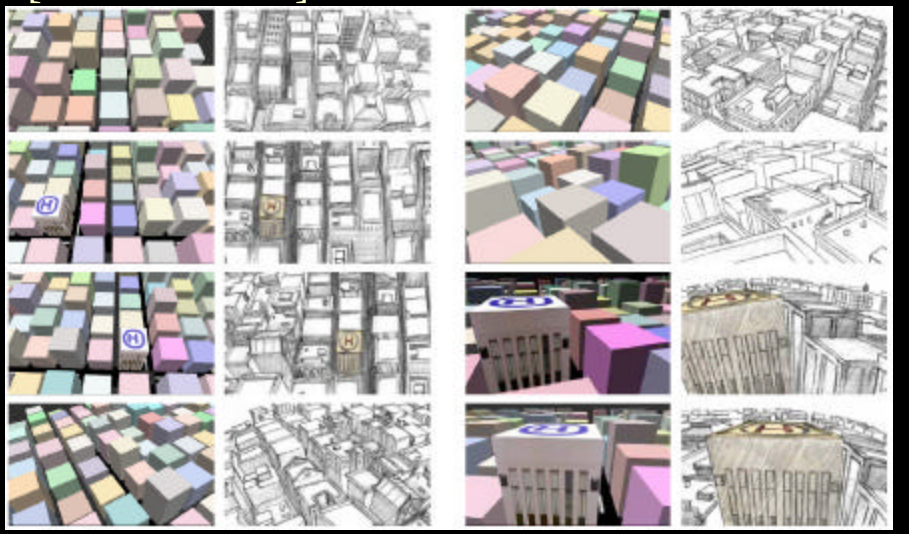
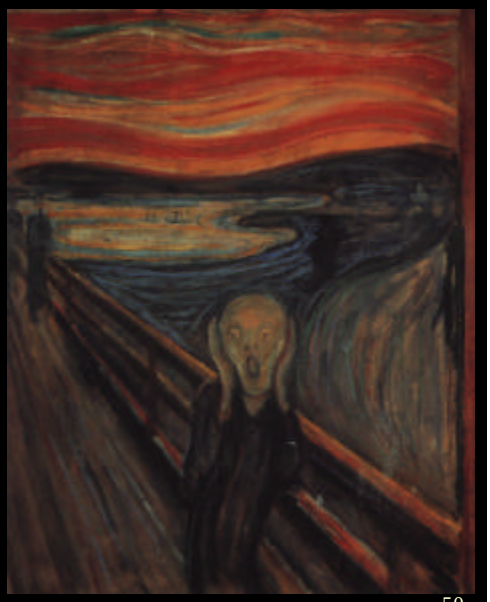


"Impressionist" perspective

- Pissaro

"Expressionist" perspective

- Munch,
  the Scream



"Expressionist" perspective

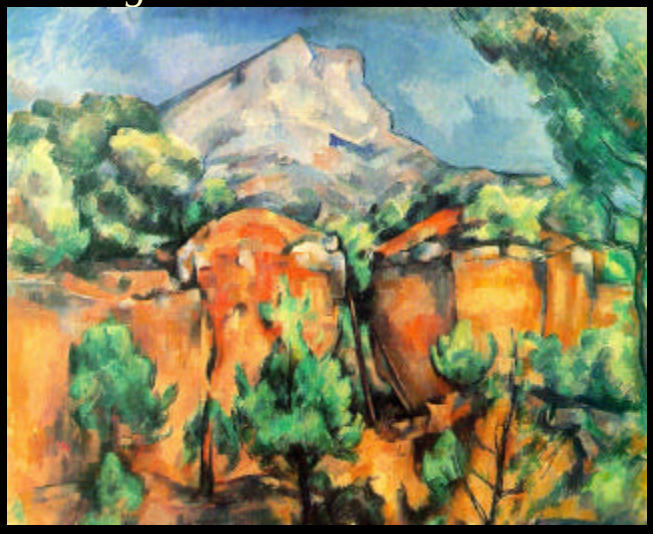
- Van Gogh

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

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  - Topological
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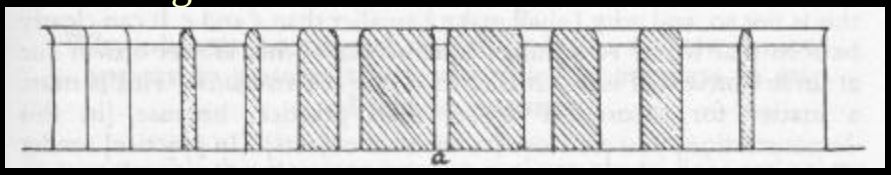
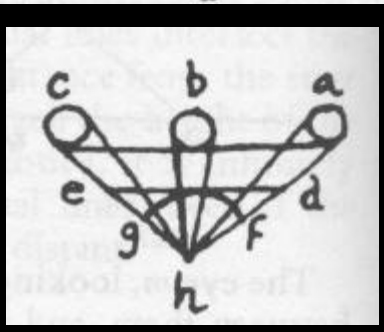
Leonardo & contradictions

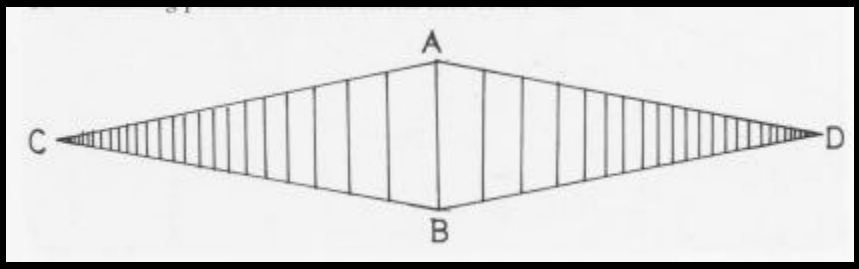
- Wide angle vision





Leonardo & contradictions

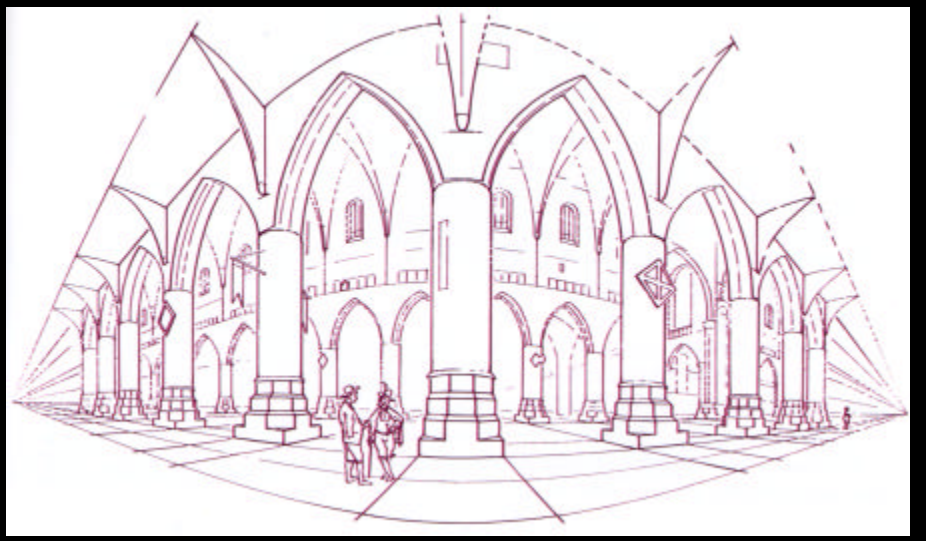
- Wide angle vision
- Lateral recession



Curved perspective

- Panorama
  - Preserve verticals
- Fish eye

Curved perspective



Curved perspective

- Jean Fouquet, 15th century

Curved perspective

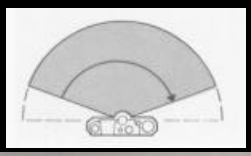
- A View of Delft Carel Fabritius (follower of Rembrandt) 1652

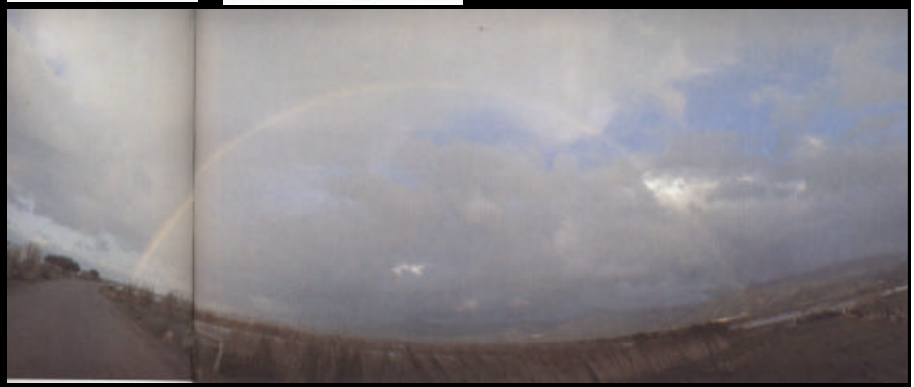
Curved perspective

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

Curved perspective

- Panoramic camera



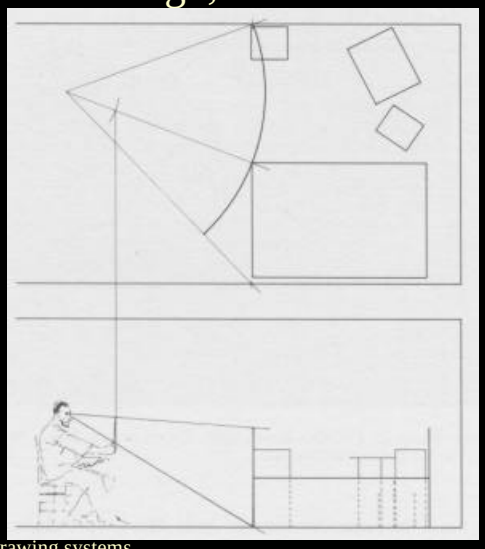


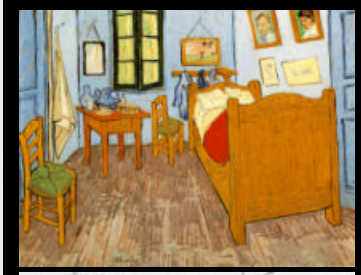
"Expressionist" perspective

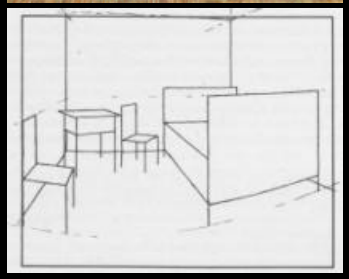
- Van Gogh, *Bedroom in Arles*

"Expressionist" perspective

- Van Gogh, *Bedroom in Arles*



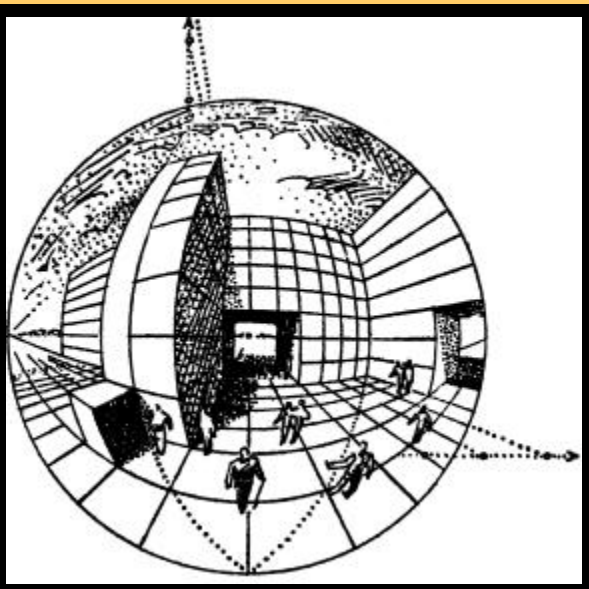




Curved perspective

- Panorama
  - Preserve verticals
- Fish eye

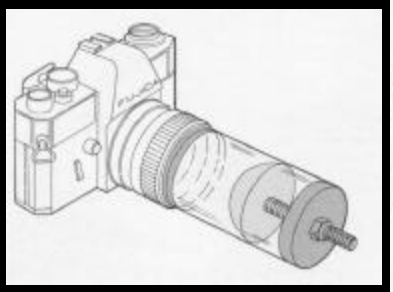
Fish-eye



Fish-eye vs. wide angle

Fish-eye vs. wide angle

Bird's eye attachment



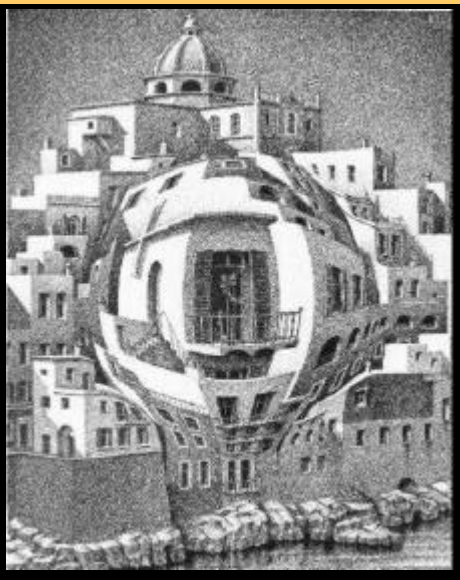
Fish-eye

Fish-eye

- MC Escher, *Hand with Reflecting Globe*

Fish-eye

- MC Escher, *Balcony*



Fish-eye

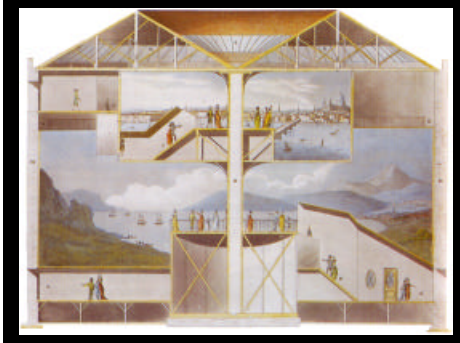
- *London from St Paul's cathedral 1845*

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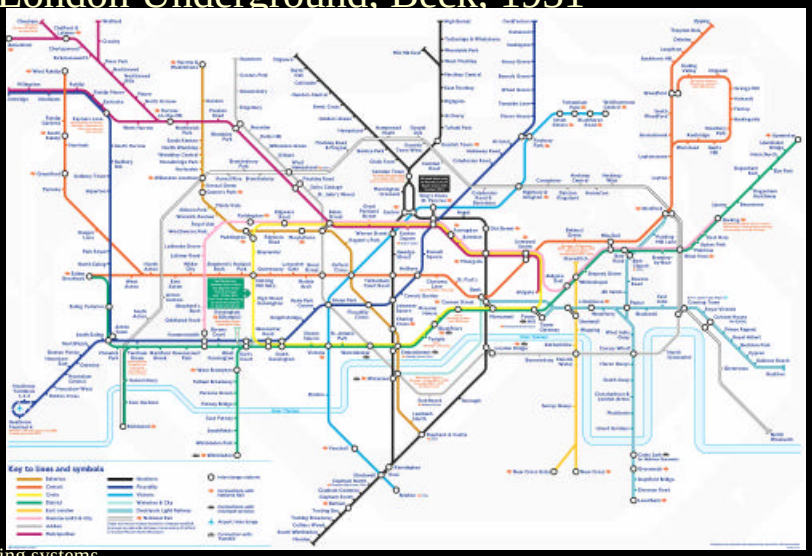
  - Topological
  - Split views, fold-out
  - Multiple viewpoints

Topological

- Paul Klee, Another Camel

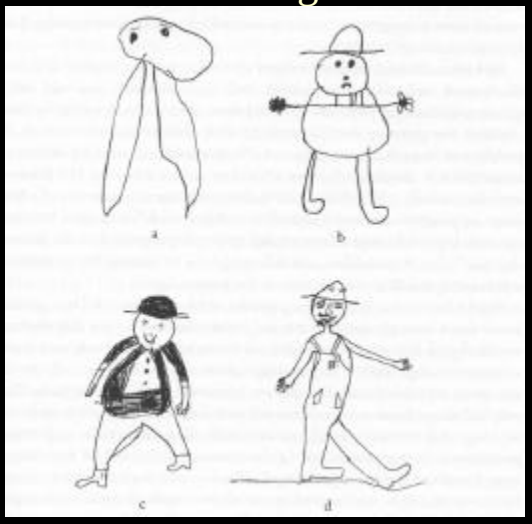
Topological

- London Underground, Beck, 1931



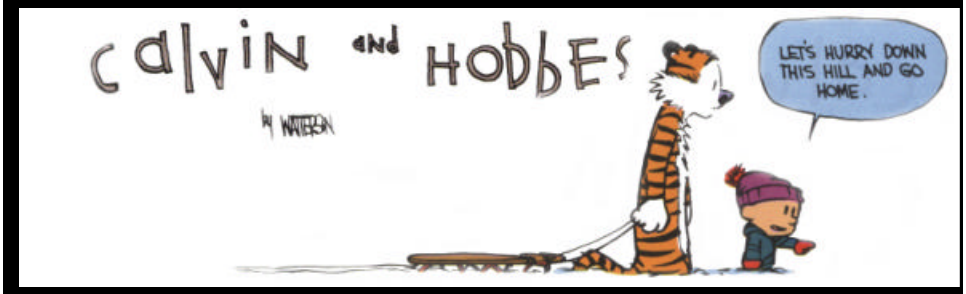
Topological

- Children drawing



Topological

- Comics



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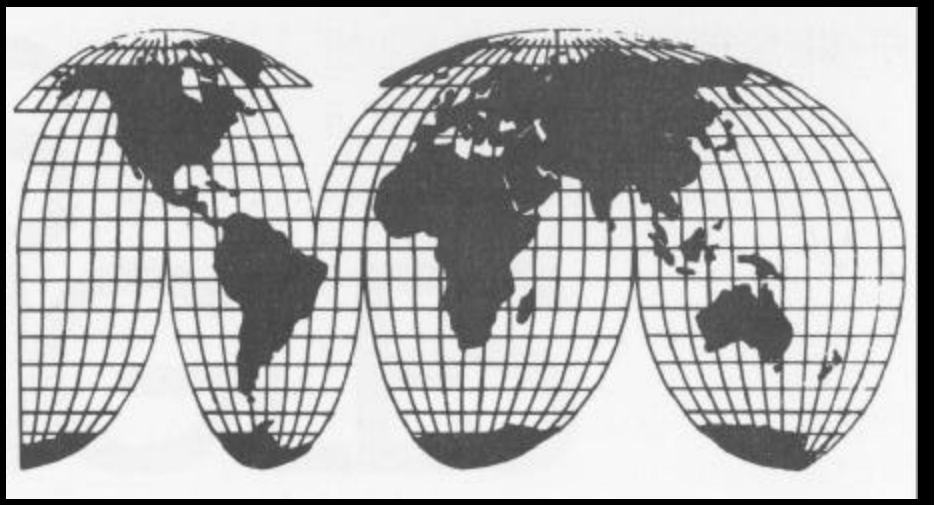
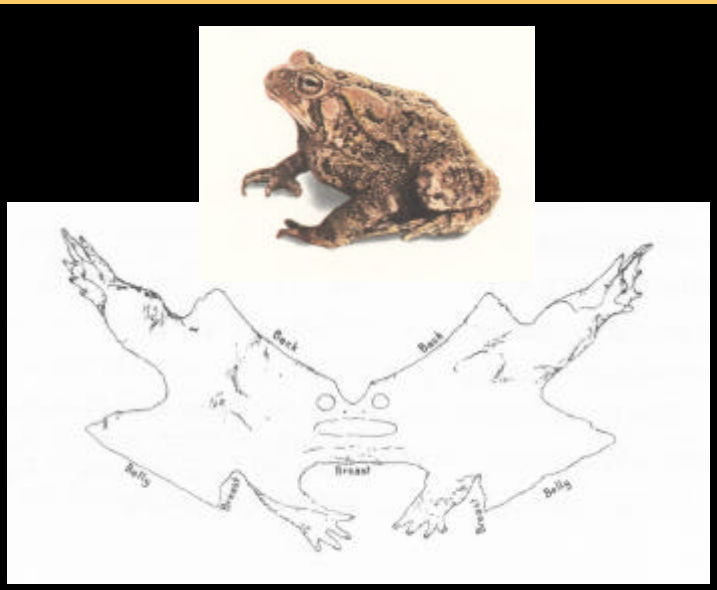
Split views, fold-out

- 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

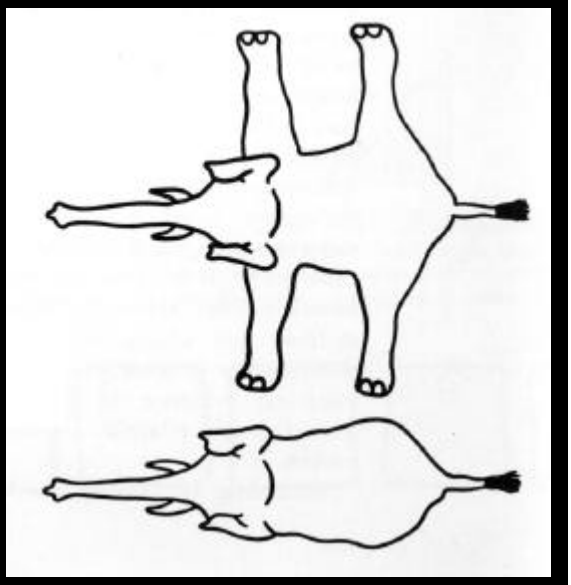
- Multiple-center of projection images, Paul Rademacher

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

Drawing systems 105

Hockney

Drawing systems 106

Escher

- *Other World* 1947

Mirrors, lenses

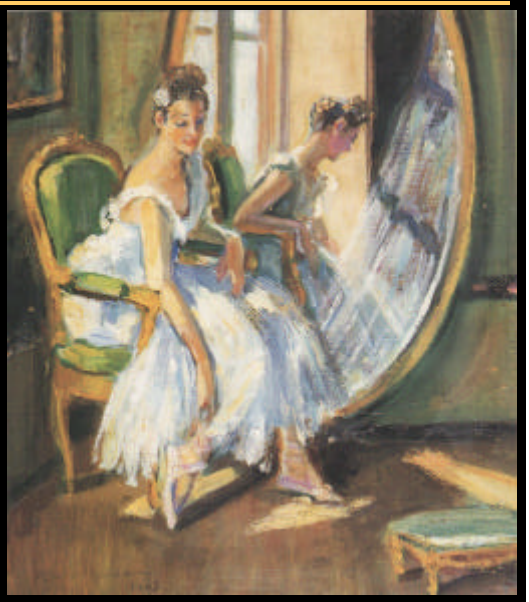
- Freddie Francis
  The Skull

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.