

*The Art and Science of Depiction*

# *Tone and color system*

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*MIT- Lab for Computer Science*

# Color and Tone System

calvin and hobbes  
by waterson



CLICK



UH OH...



THE SKY IS A DEEP ORANGE! CALVIN'S SKIN IS A PALE GREEN! YELLOW FLOWERS ARE NOW BLUE!



EVERY COLOR IS THE OPPOSITE OF WHAT IT SHOULD BE!



CALVIN HAS BEEN TRANSFERRED TO A COLOR FILM NEGATIVE!



HIS ONLY HOPE IS TO BE PROCESSED BY A 1-HOUR PHOTO FINISHER! DEVELOPER! I NEED DEVELOPER!



DOGGONE IT, CALVIN! THAT'S ANOTHER PICTURE RUINED! CAN'T YOU LOOK PLEASANT FOR 1/500TH OF A SECOND?!



Tone & color system

# *Representation systems*

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- Drawing and projection
- Denotation
- Tone & color

# *Tone & color system*

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- (Often a mix)
- Extrinsic
- Intrinsic
- Symbolic



# Extrinsic color

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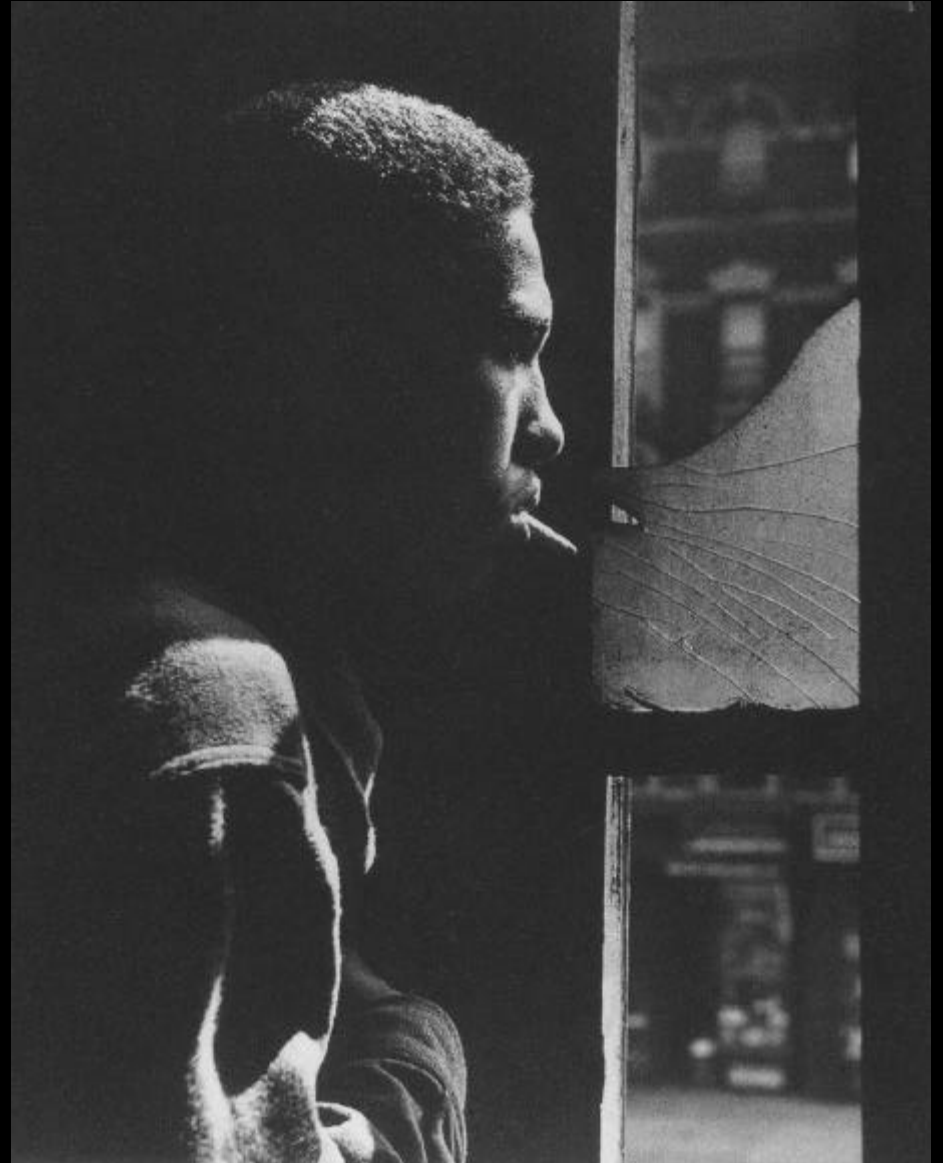
- Renzo Piano  
Tjibaou  
cultural  
center  
1991-98



# Extrinsic black and white

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- Gordon Park,  
*Red Jackson*  
*Gang Leader*





# *Optical intrinsic*

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- Boticelli *Primavera* 1482

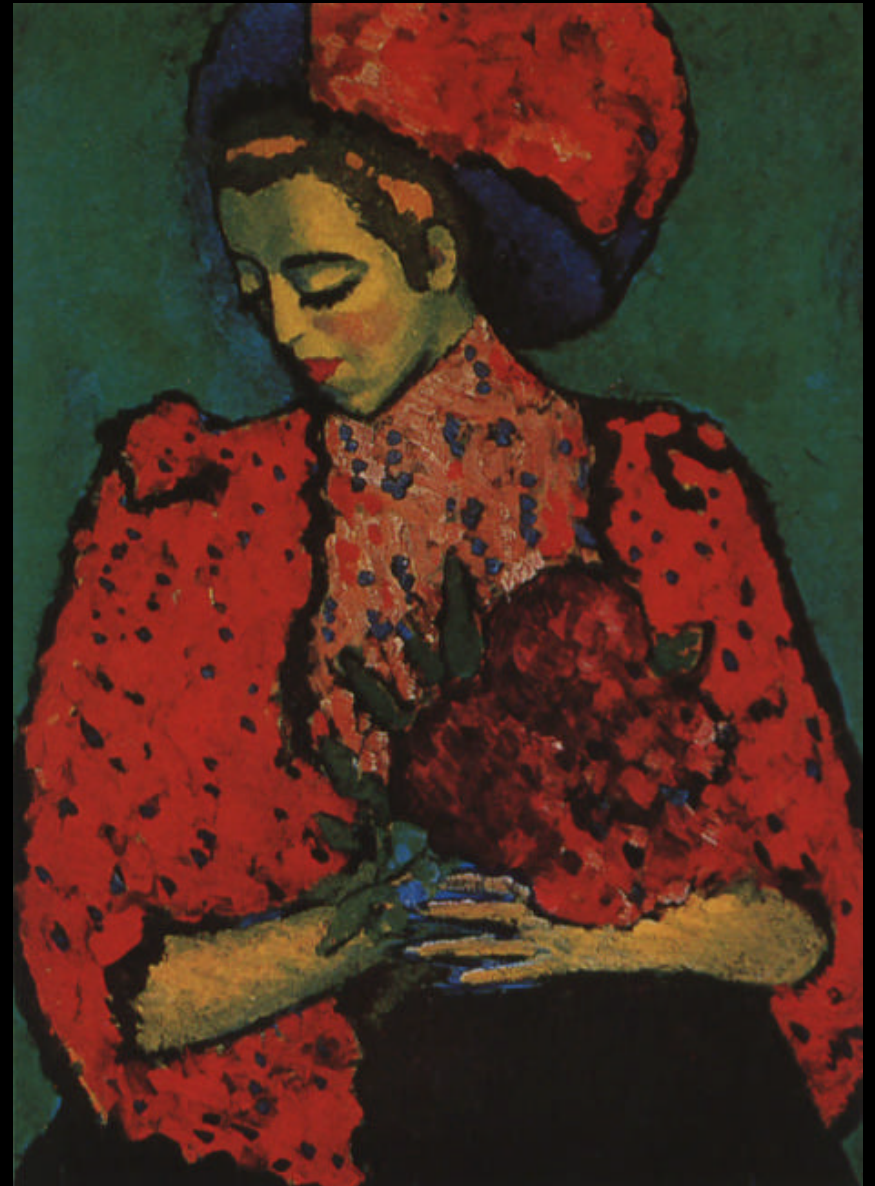


Tone & color system

# *Pure intrinsic colors*

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- Jawlensky  
*Girl with Peonies*
- +*symbolic*+*harmony*



# *Plan*

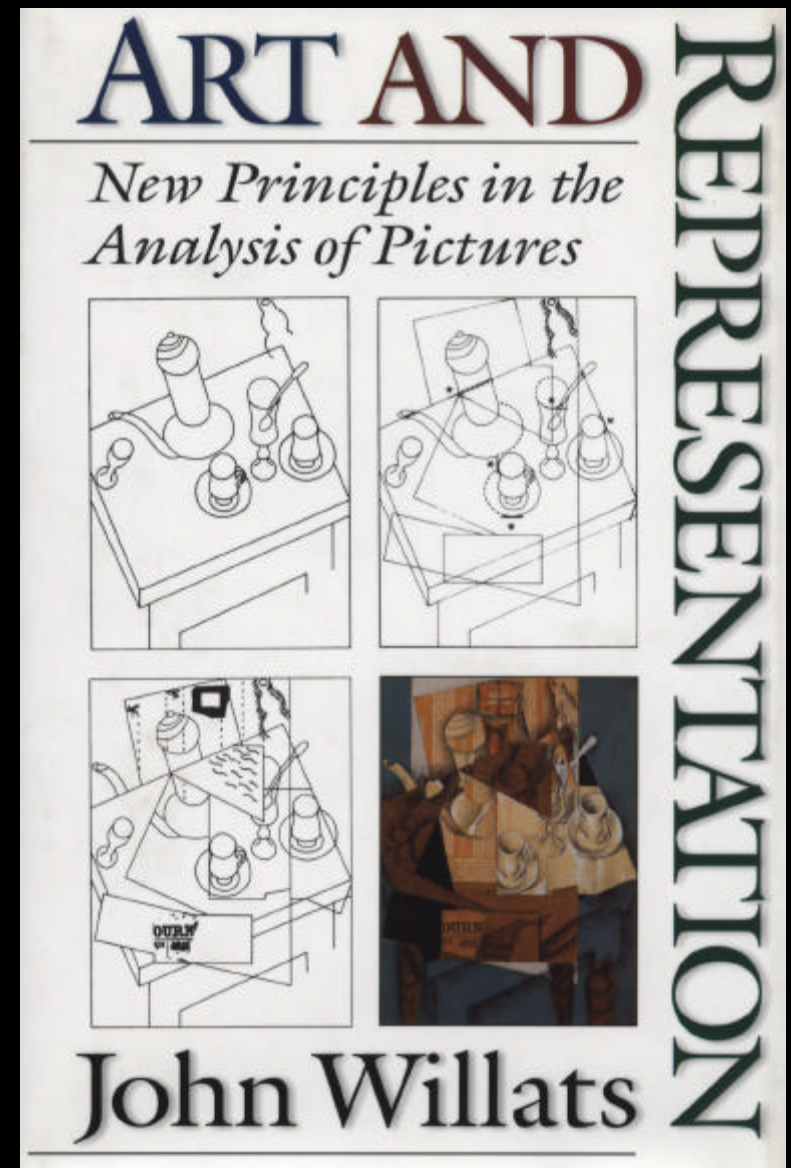
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- Intro
- Shading
- Shadows
- Atmospheric perspective
- Light transfers
- Photography



# *Why a separate system?*

- Willats discusses it only/mainly for the optical denotation system
- But historically it is the major issue with drawing
- It is clearly a different problem from that of dimension and denotation
- Relevant as well for other denotation systems



# *Denotation system and tone & color*

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- Silhouette: color of the regions
- Line drawing
  - Line color
  - Line thickness
- Optical
  - Point color & tone
  - Texture
- More an “attribute system” than just tone & color



# *Denotation system and tone & color*

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# *Denotation system and tone & color*



Tone & color system



# *Denotation system and tone & color*

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- Braque Un Poeme Dans Chaque Livre





# *Denotation system and tone & color*

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Tone & color system

# *Denotation system and tone & color*

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- Amedeo Modigliani  
*Tete et buste de profil  
avec boucle d'oreille*  
1912

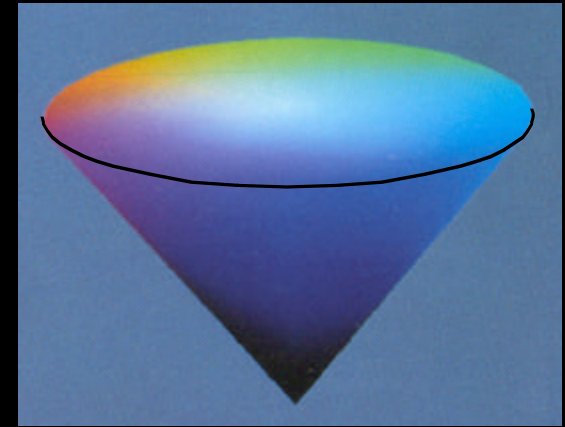




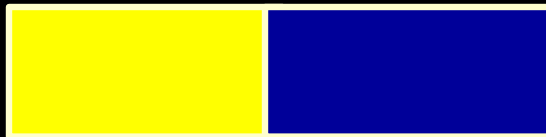
# *Picture color dimensions*

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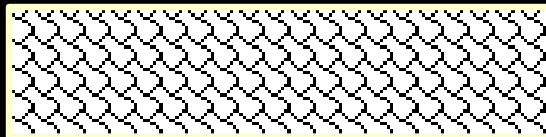
- Tone
- Hue
- Saturation



- Simultaneous contrast



- Texture



# *Beyond color*

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- Material properties
- Painting
- Gold
- Etc.



# *Color origin*

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- Physical extrinsic
- Physical intrinsic
- Symbolic/importance
- Color harmony
- Limitation compensation (or accentuation)

# *Color and symbol*

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Tone & color system

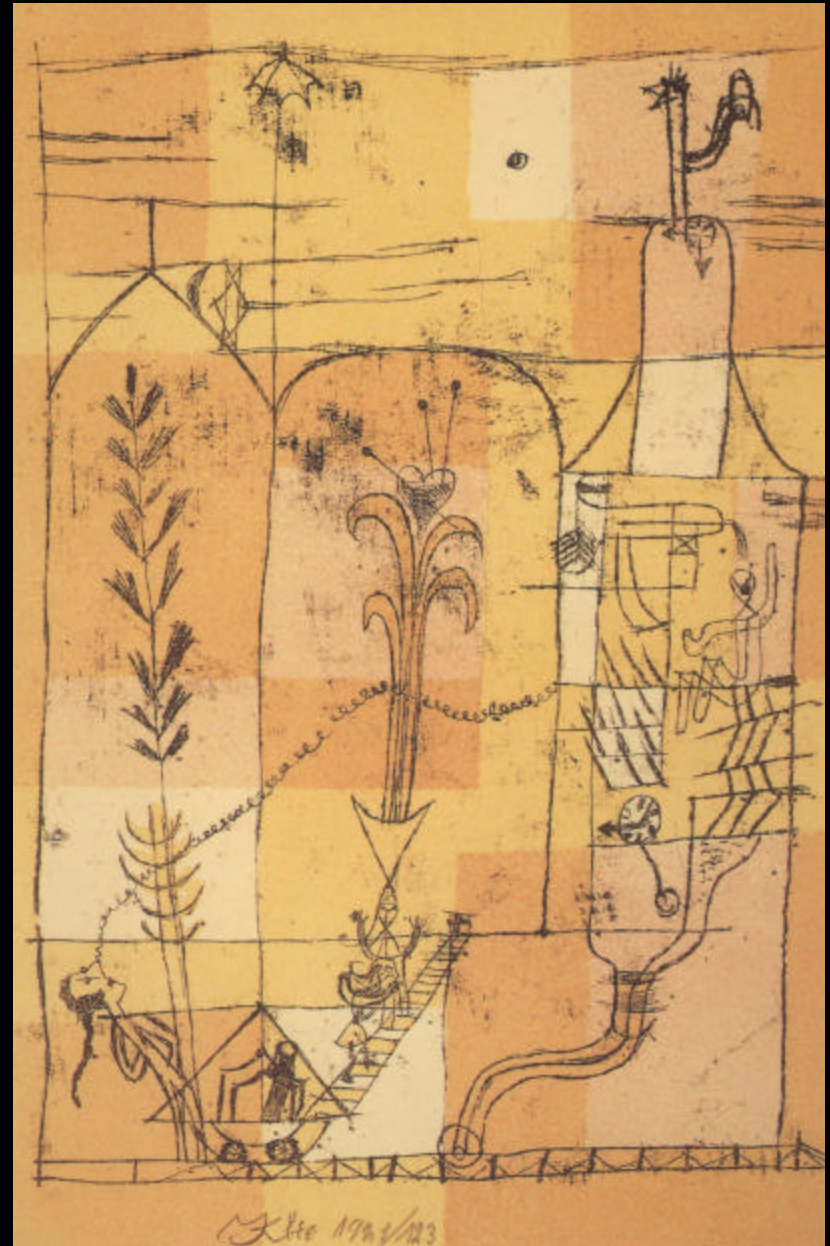
# *Issues*

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- 2D/3D
  - 2D color composition
  - Color linked to the 3D scene
- Per mark/per primitive
  - Is the color constant on a mark?
  - Is it constant on a primitive?
  - Does it vary in the mark

# Example

- Paul Klee  
*Hoffmanneske Szene*  
1921



# Example

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Tone & color system



# *Palette and medium*

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- Different media permit different ranges of colors
  - E.g. pastels, pencil, watercolor, b/w photo
- The medium can be chosen for the palette



Tone & color system

# *Color and aging*



Tone & color system



# *Restoration*

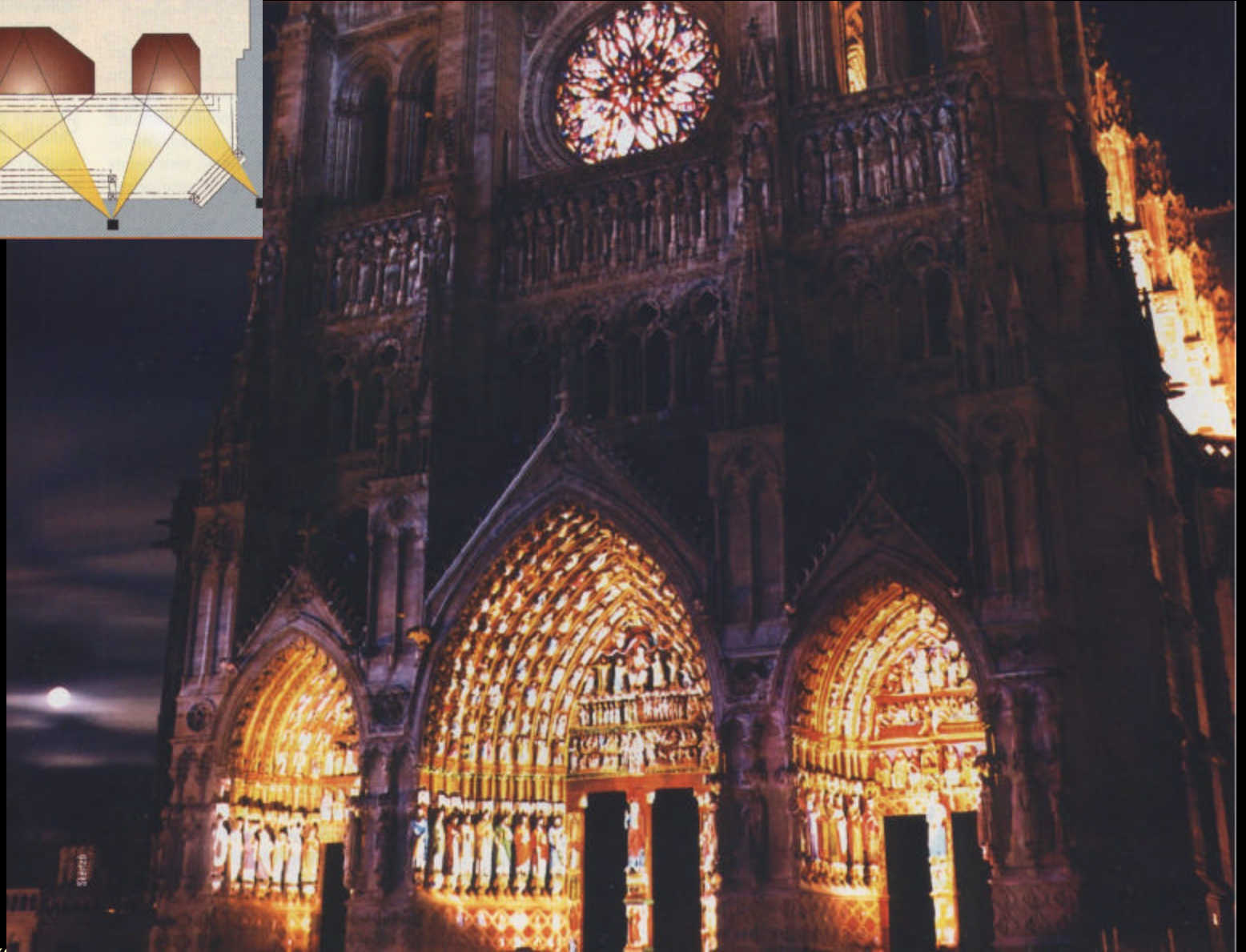
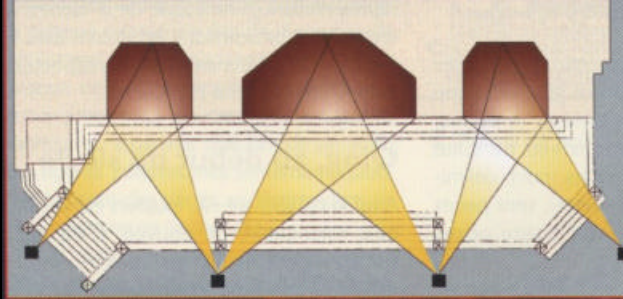
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- Michelangelo The Creation of Adam 1508-1512



Tone & color system

# *Church and color*



Tone & color system



# *Church and color*

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Tone & color system

# *Light in the scene*

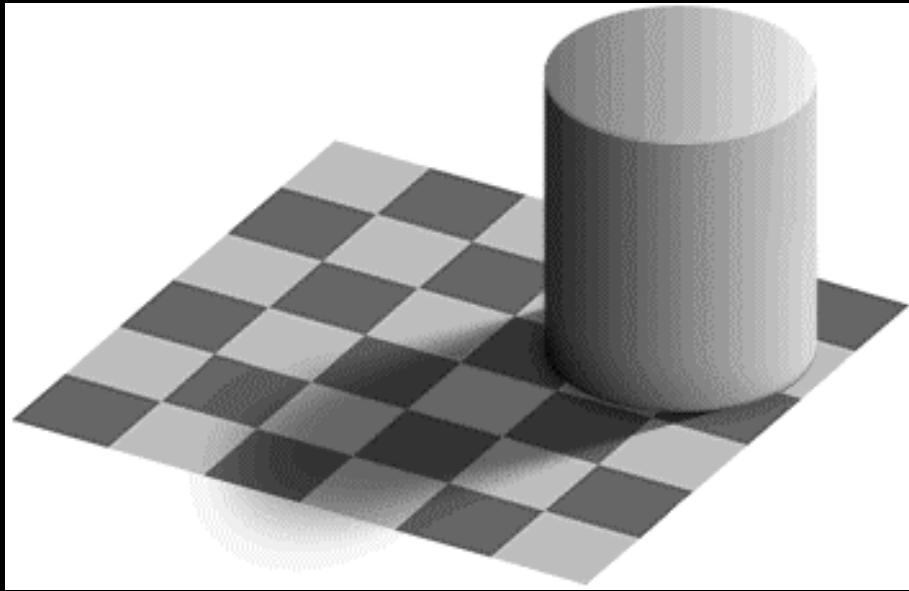
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- Intrinsic reflectance
- Different light sources
- Outgoing light
- Shadows
  - Self shadows
  - Cast shadows
- Shading
- Inter-reflection
- Atmospheric perspective

# *Constancy and scene analysis*

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- Segmentation into layers
  - Illumination
  - Reflectance
  - Transparency



# *Light*

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- Point light source
- Directional light source (sun)
- Extended light source
- Hemispherical light source (sky)
- Ambient light
- Global illumination

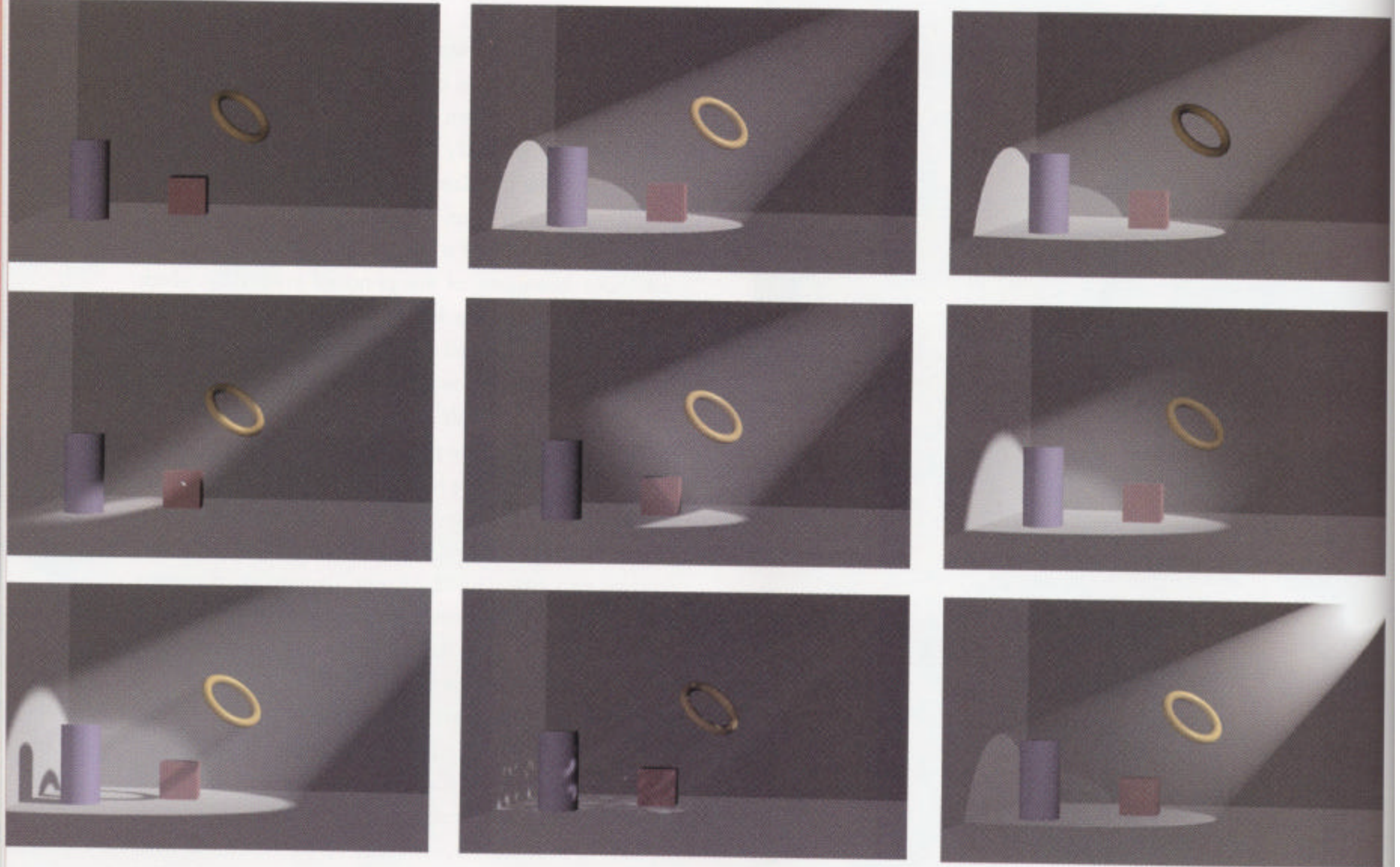
# *Light*

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- Fall-off
- Attenuation



# Light in CG



# *Plan*

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- Intro
- Shading
- Shadows
- Atmospheric perspective
- Light transfers
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# *Light and shape depiction*

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- Shading
- Highlight
- Shadow
- Inter-reflection

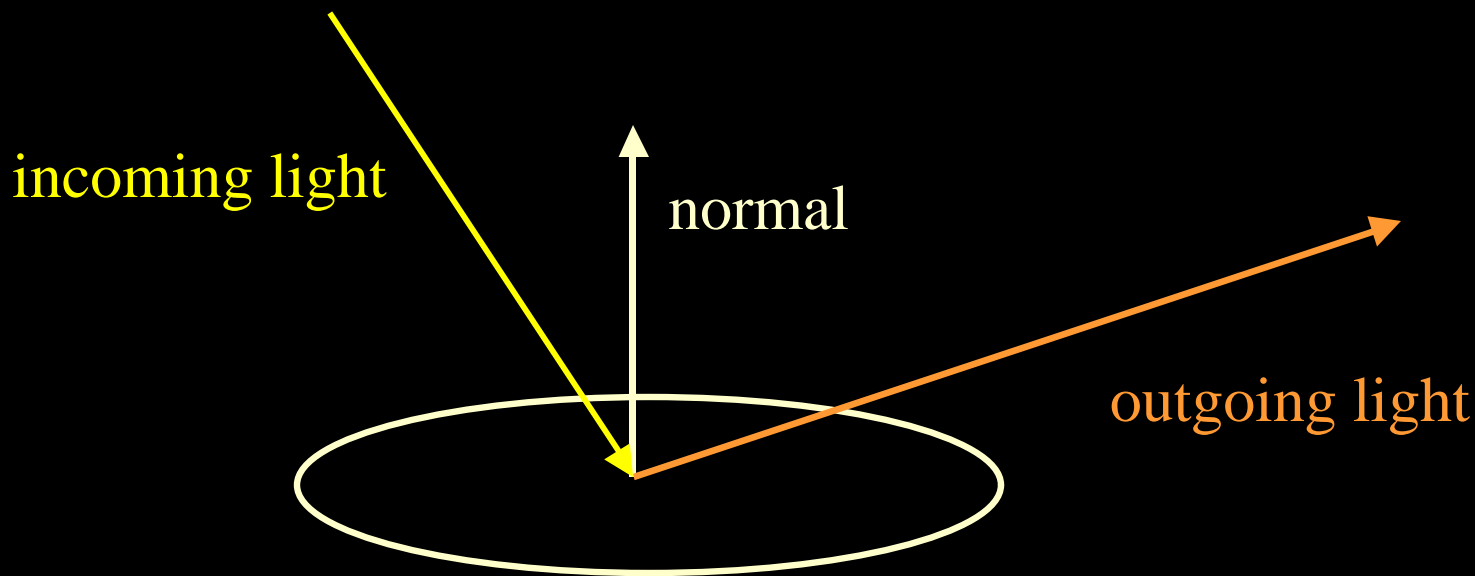




# Shading & BRDF

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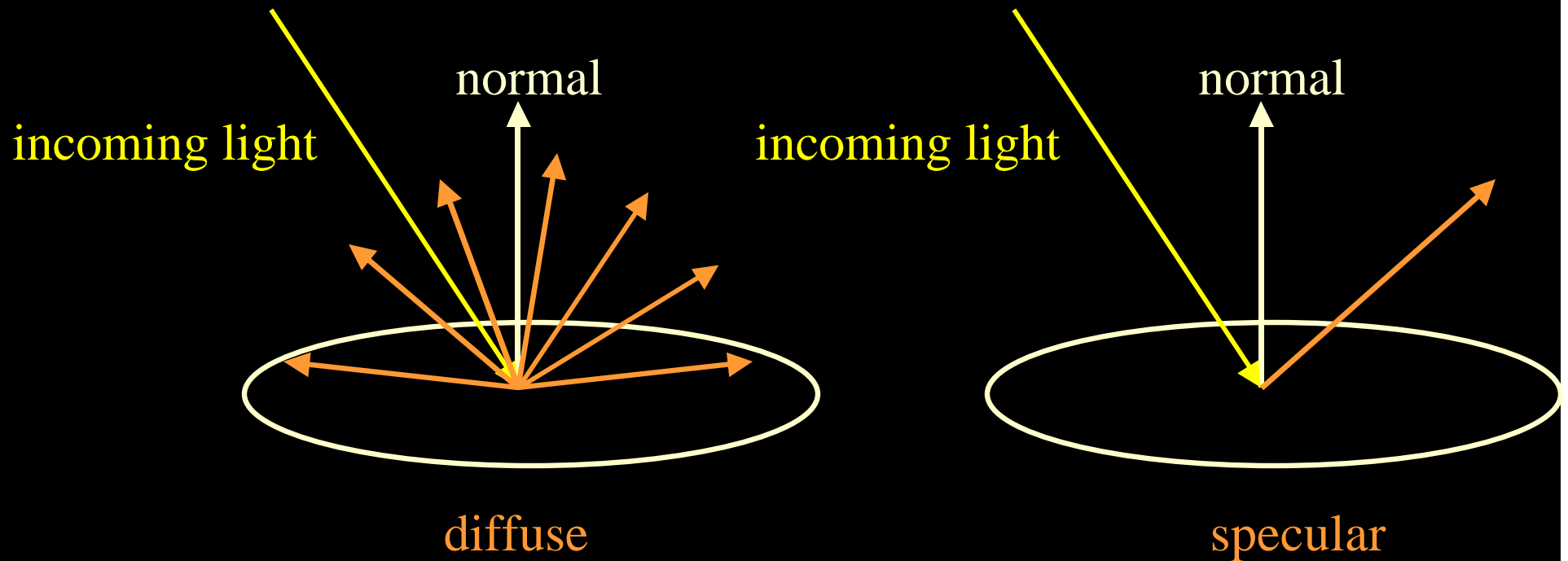
- Bi-Directional Reflectance distribution function
- Ratio of light arriving from one direction bouncing in another direction
- 4D function (2\*2 angles)



# Shading & BRDF

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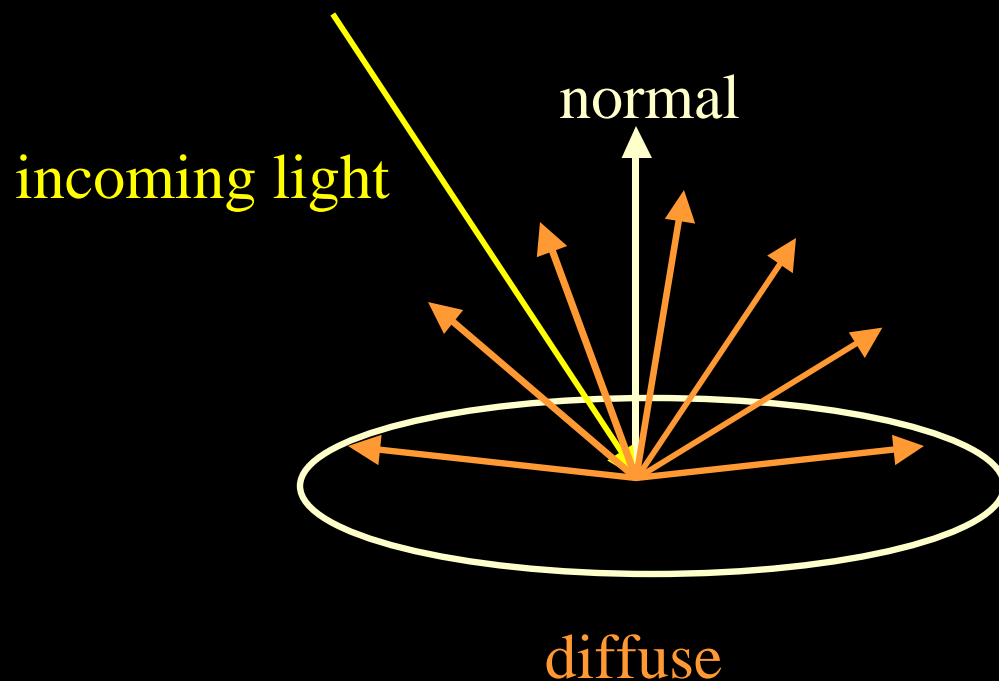
- 2 main components
  - Diffuse (omni-directional)
  - Specular (directional) : highlight



# Shading & BRDF

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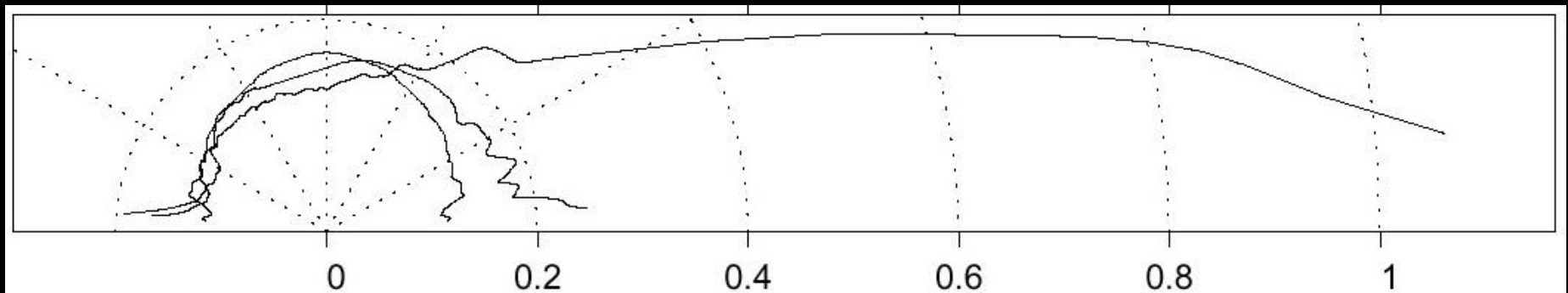
- Diffuse
  - Depends on angle between light and normal





# *Shading & BRDF*

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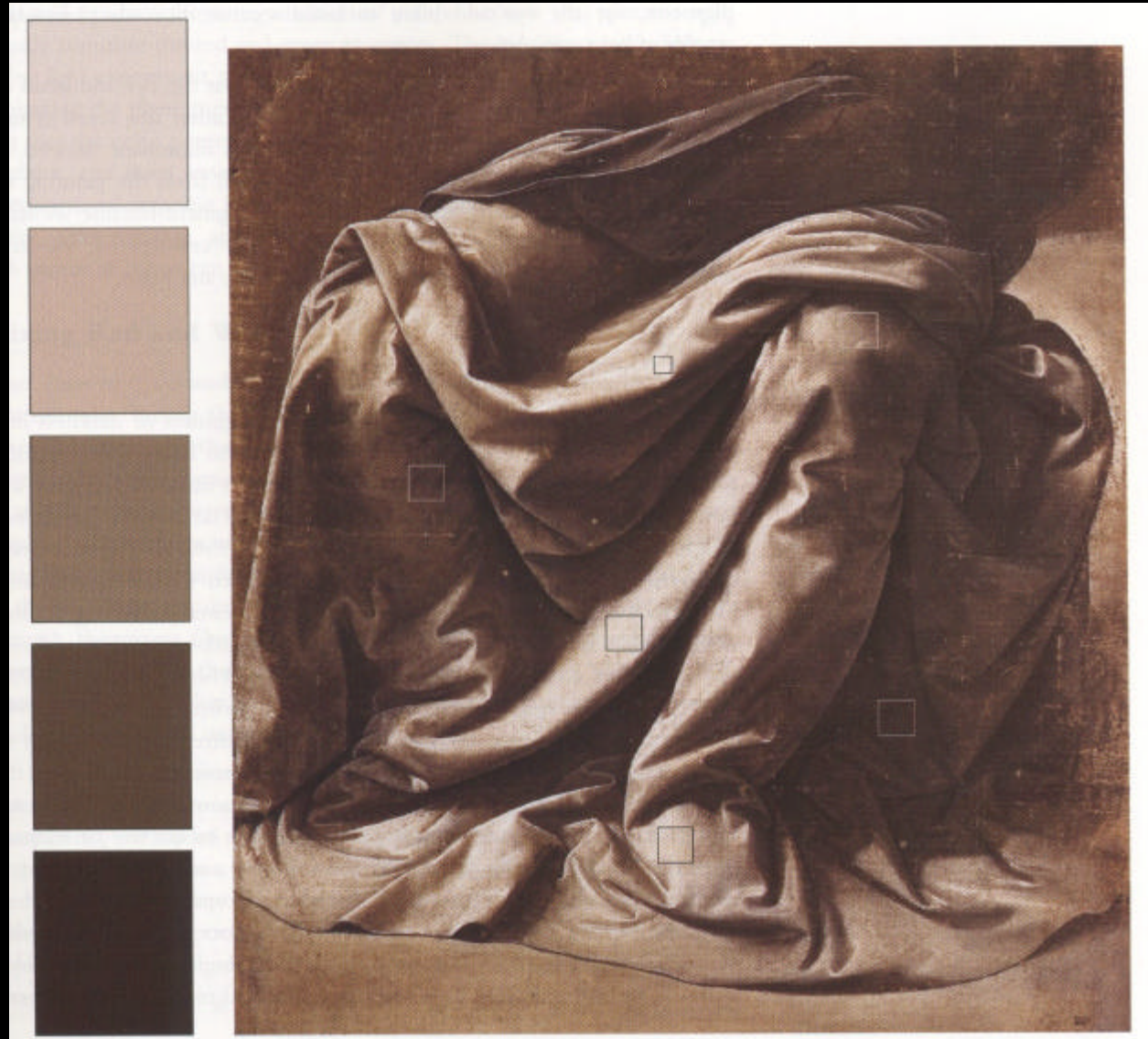
# Shading & BRDF



Tone & color system

# *Chiaroscuro*

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# *Saturation shading*

- Andreas Mantegna, *Madonna and Child with St John the Baptist and Mary Magdalene*, 1495



# *Saturation shading*

- Andreas Mantegna,  
*Madonna and Child  
with St John the  
Baptist and Mary  
Magdalene,*  
1495





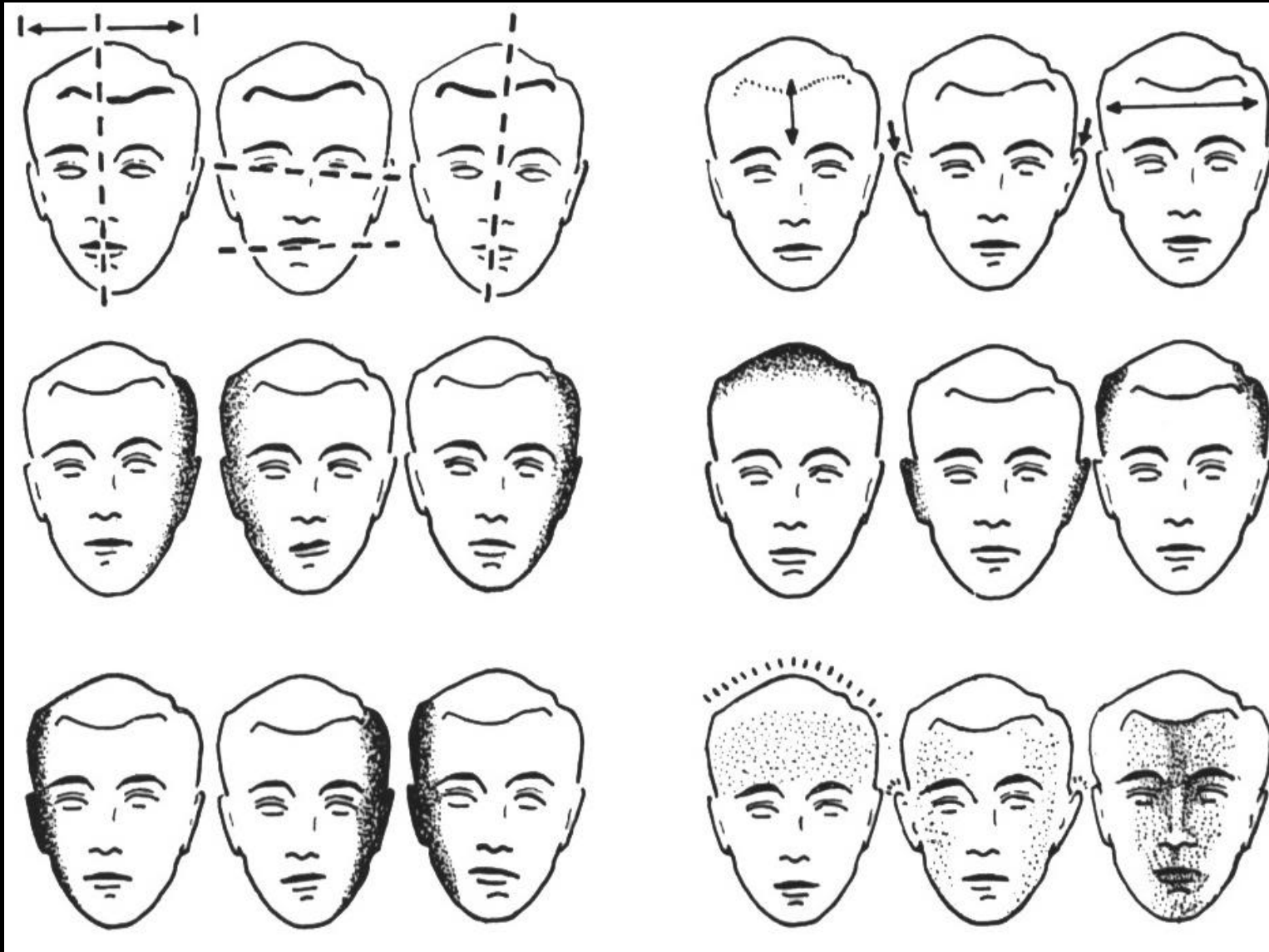
# *Shading and make up*

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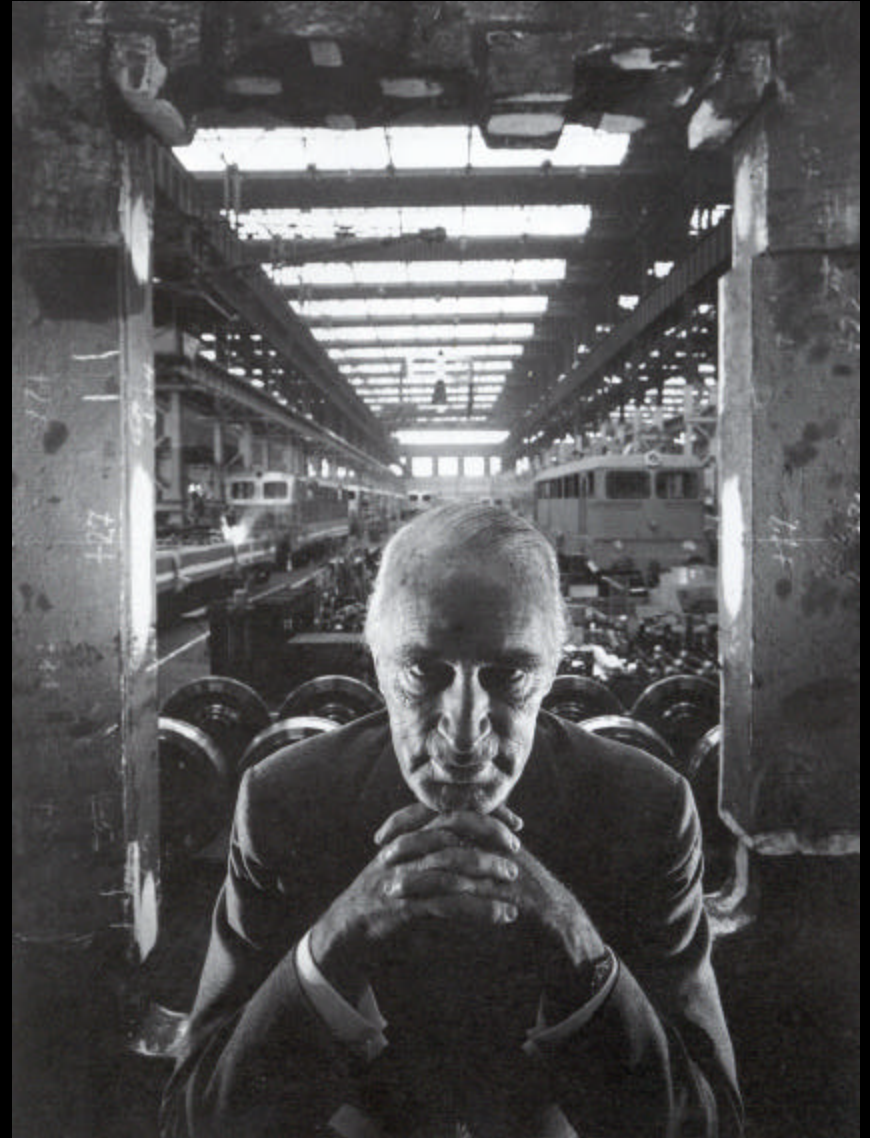
# *Shading and corrective lighting*



# *Lighting and shading*

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- Alfred Krupp photographed in 1963 by Arnold Newman
- Because Krupp had benefited from the nazis
- Un-friendly lighting



# *Plan*

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- Intro
- Shading
- Shadows
- Atmospheric perspective
- Light transfers
- Photography

# Shadow

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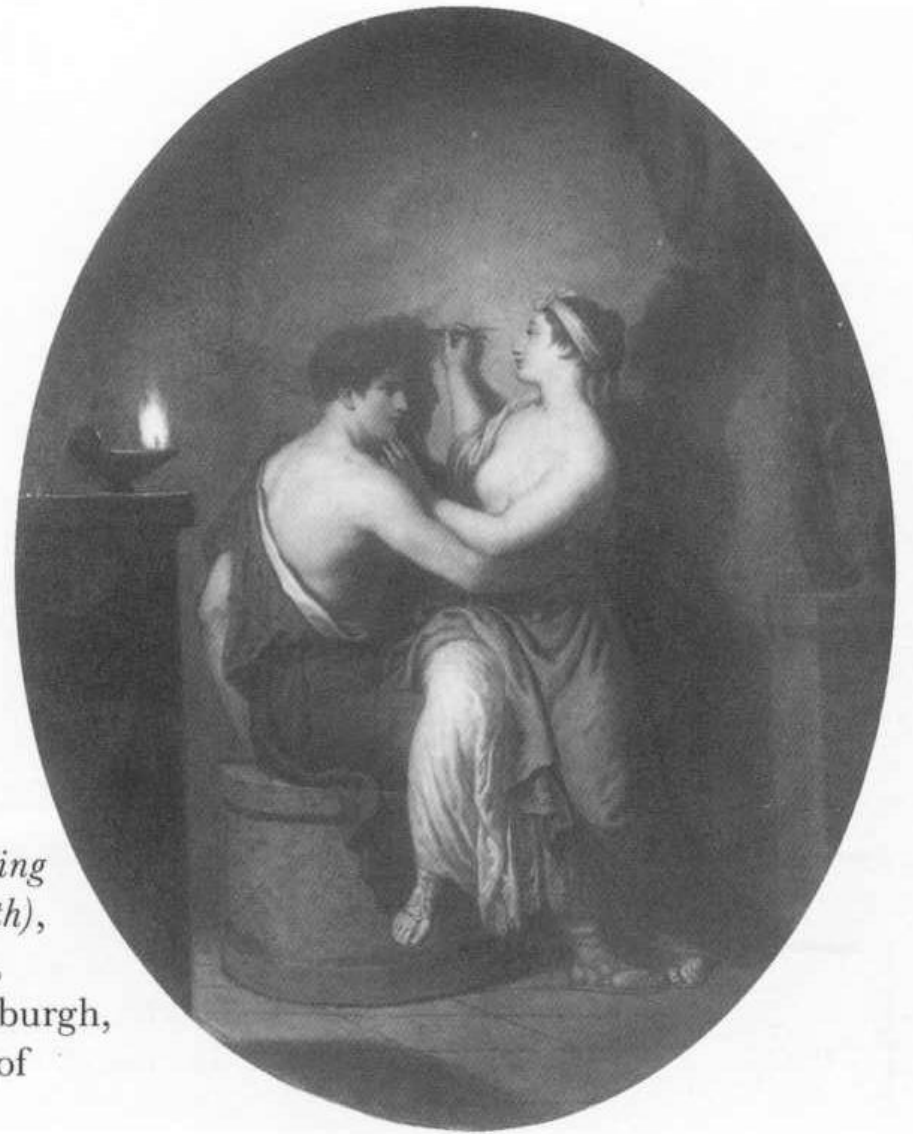


Plate 18  
David Allan,  
*The Origin of Painting*  
(*The Maid of Corinth*),  
1775. Oil on wood,  
38.7 x 31 cm. Edinburgh,  
National Gallery of  
Scotland.

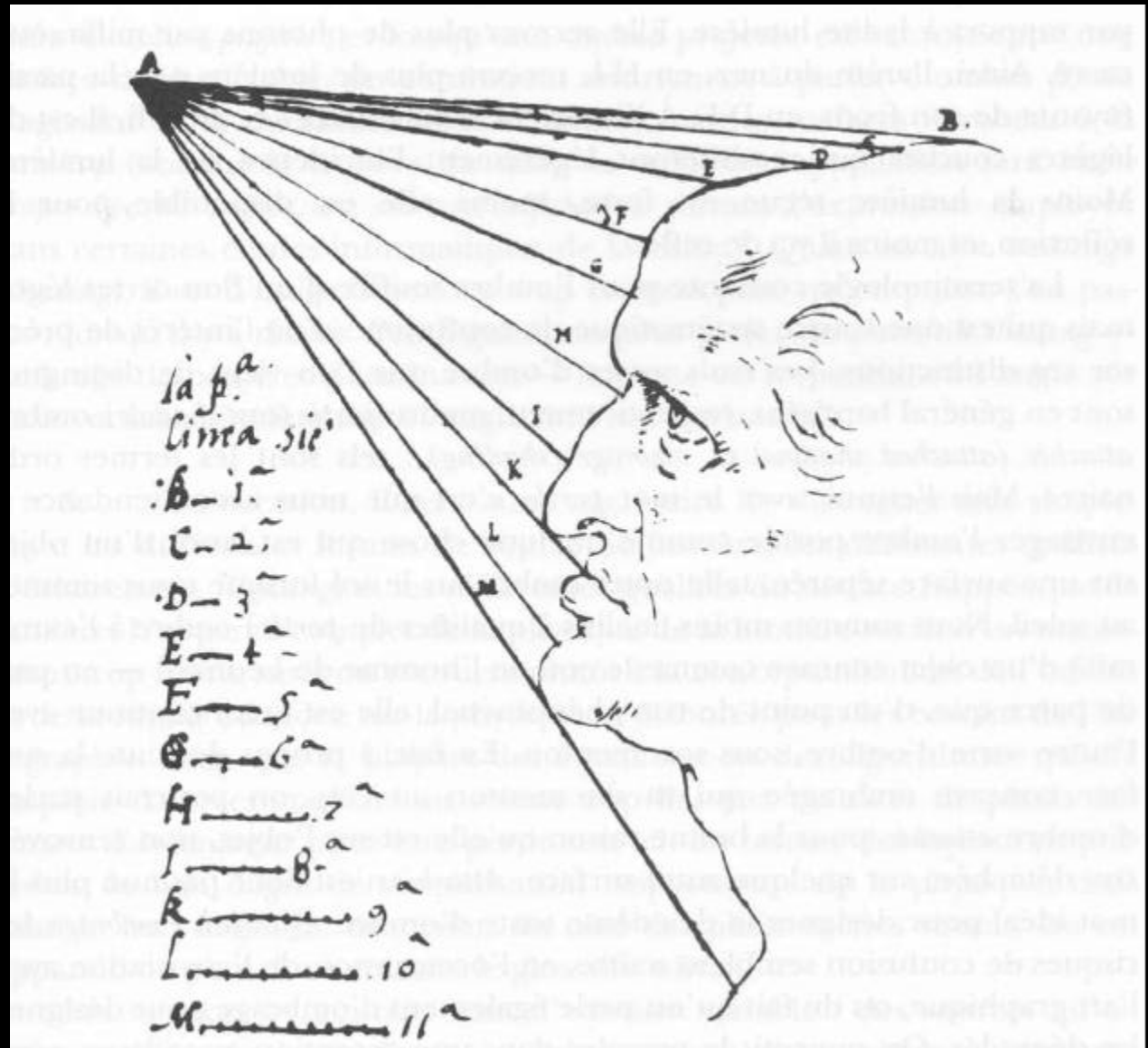


# *Shadow*

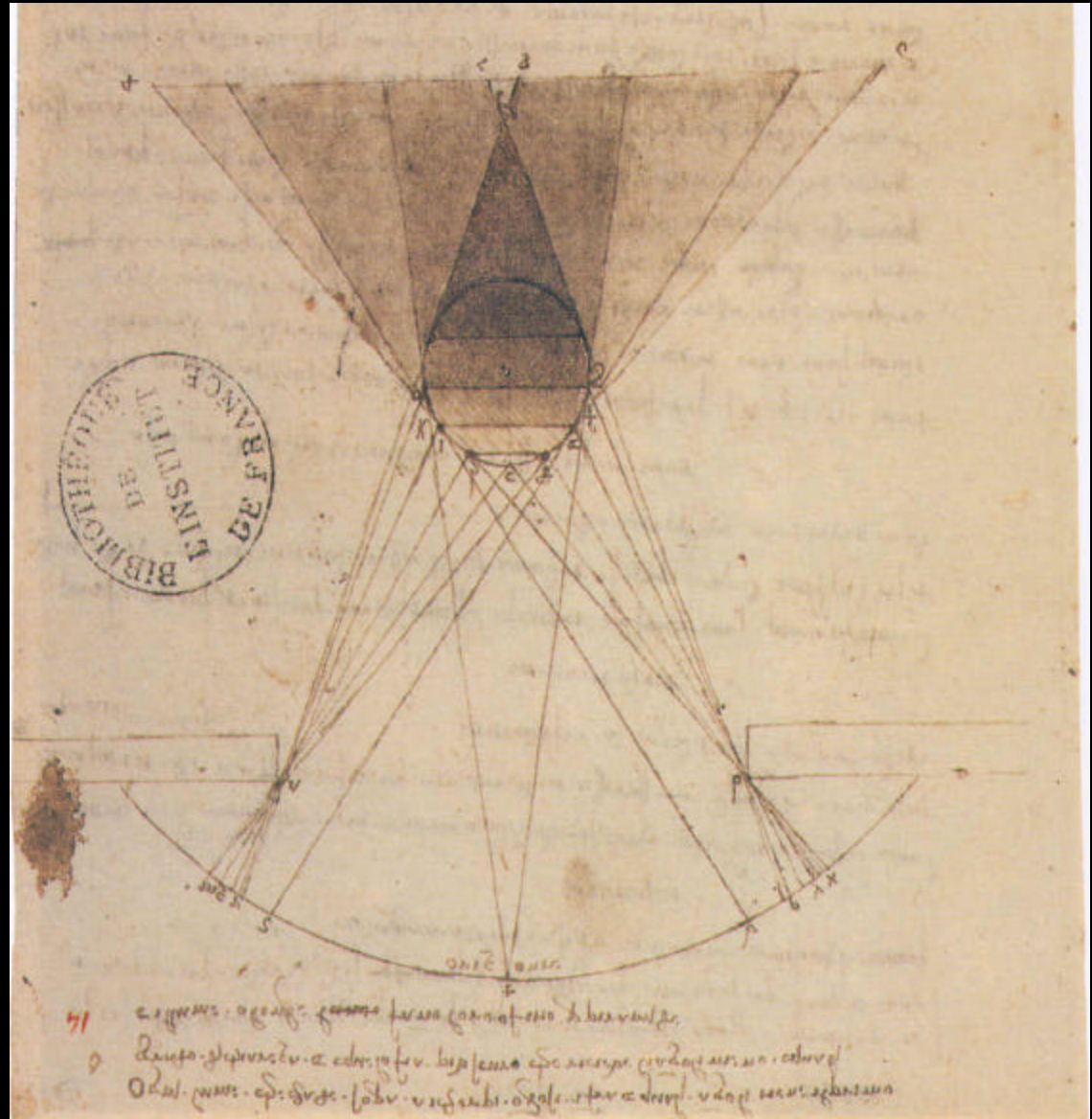
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- Self , cast and attached shadows
  - (or primary and secondary, double shadow, etc.)
- Not local
- Can be distracting
- Have been depicted or not depending on period
  
- Hard/soft shadow

# Self and cast shadow

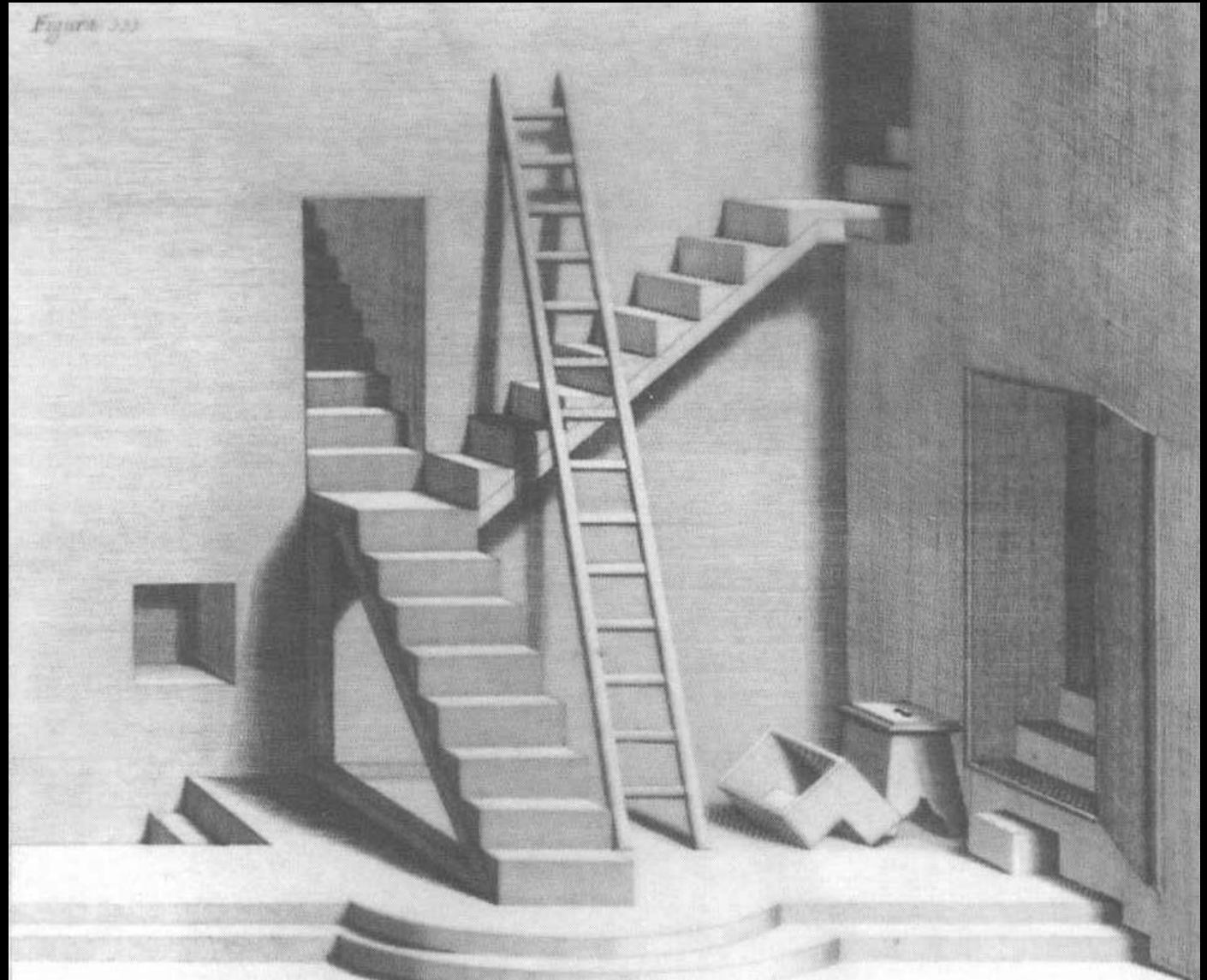


# Soft shadow



# Shadow

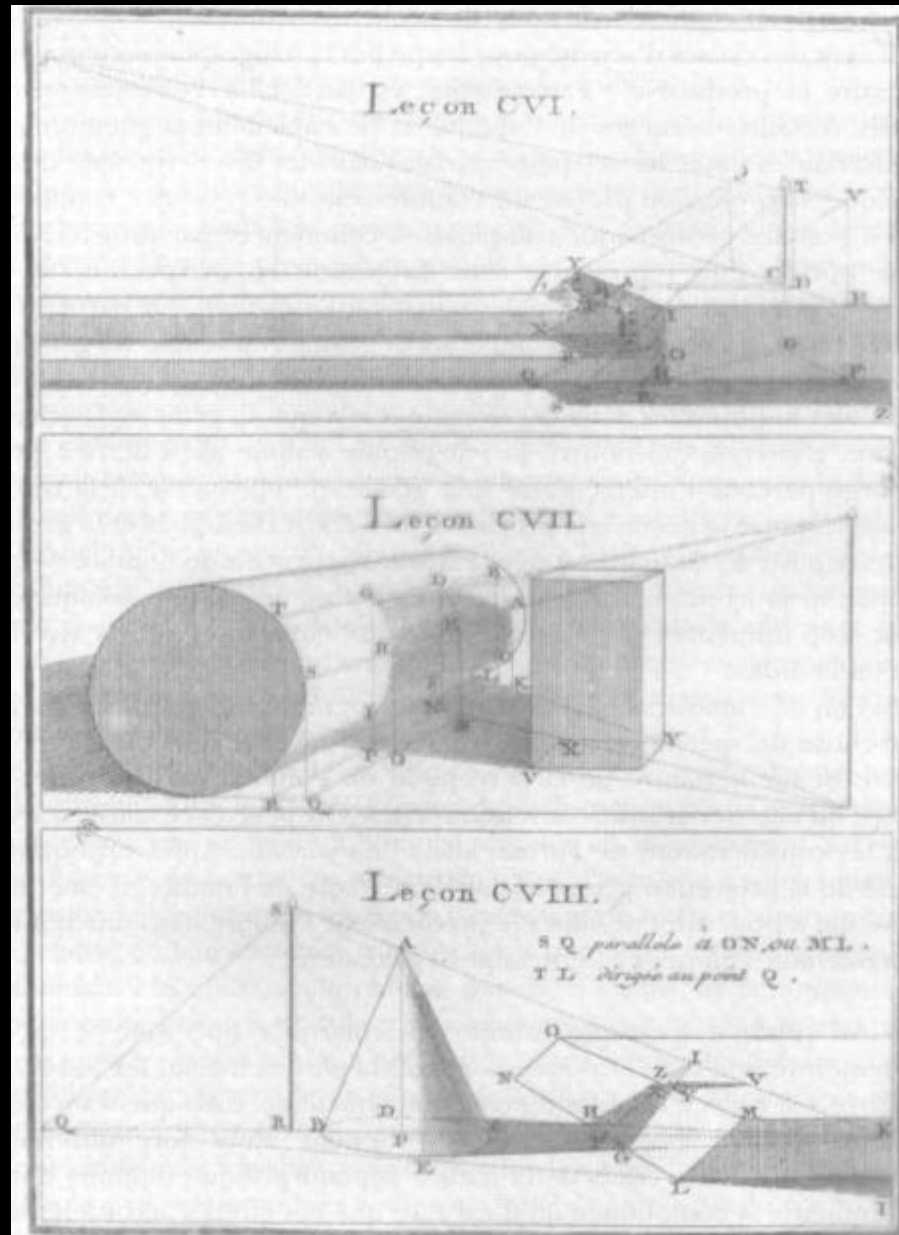
- Pozzo





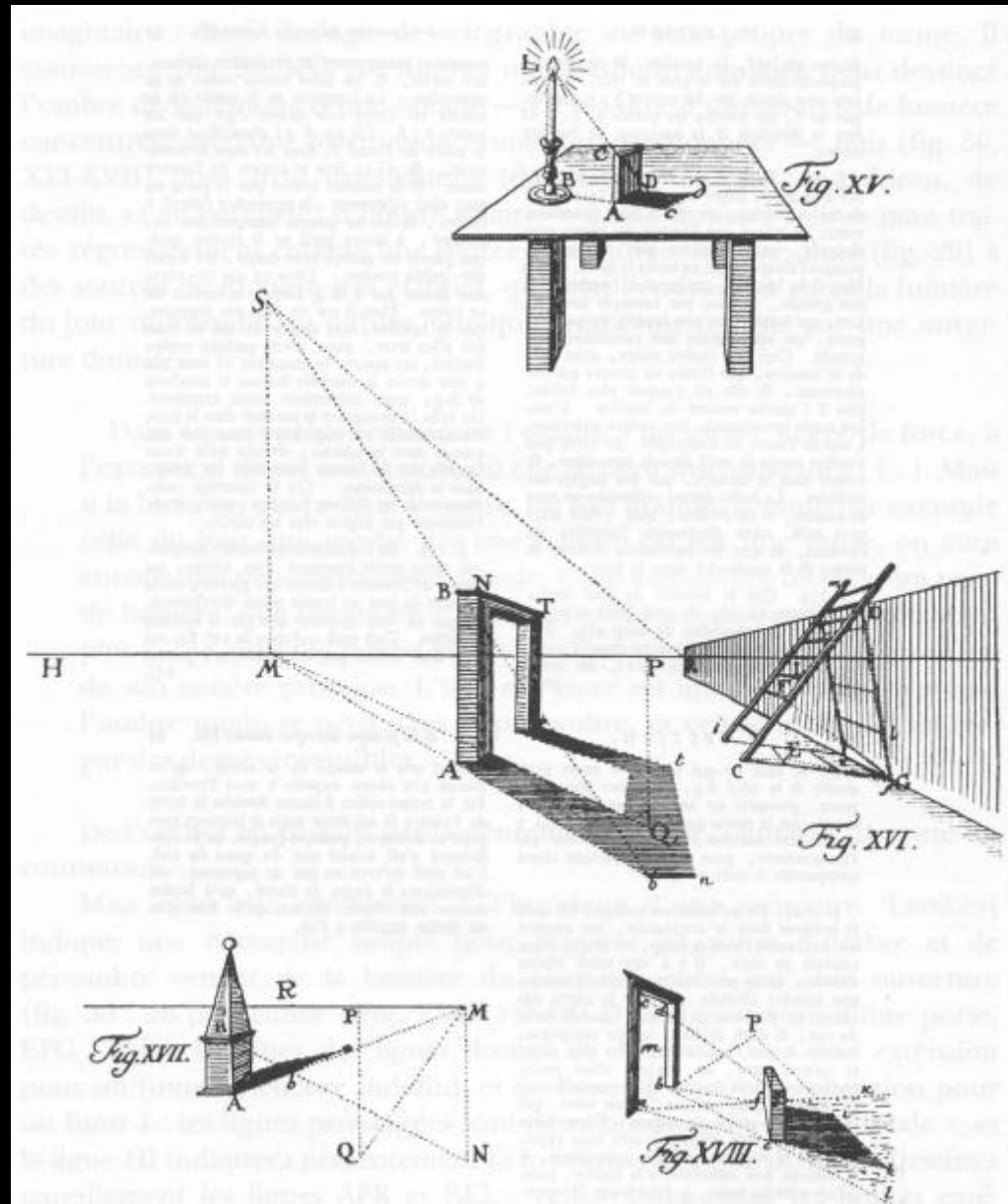
# Shadows

- 18<sup>th</sup> century



# Shadows

- 18<sup>th</sup> century
- Lambert



# Shadow

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- Raphael vs. Master of the Mornauer



Tone & color system

# Shadow

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- Campin, *Trinity* 1427-32





# *Shadow*

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- Caravaggio The Supper at Emmaus 1601



Tone & color system

# *Shadow*

- Guardi 1755





# Shadow



Plate 30 Gerrit Berckheyde, *The Marketplace and the Grote Kerk at Haarlem*,  
1674. Oil on canvas, 51.8 x 67 cm.  
London, National Gallery.

# *Shadow*

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- Rembrandt





# *Shadow*

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- Follower of Rembrandt A Man seated reading at a table in a lofty room 1631-50



# Shadow & Trompe-l'oeil

- Rembrandt



# *Shadow & Trompe-l'oeil*

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Plate 27 Unknown Swabian Artist, *Portrait of a Woman of the Hofer Family*,  
c. 1470. Oil on silver fir, 53.7 x 40.8 cm.  
London, National Gallery.



# *Shadow reveal shape*

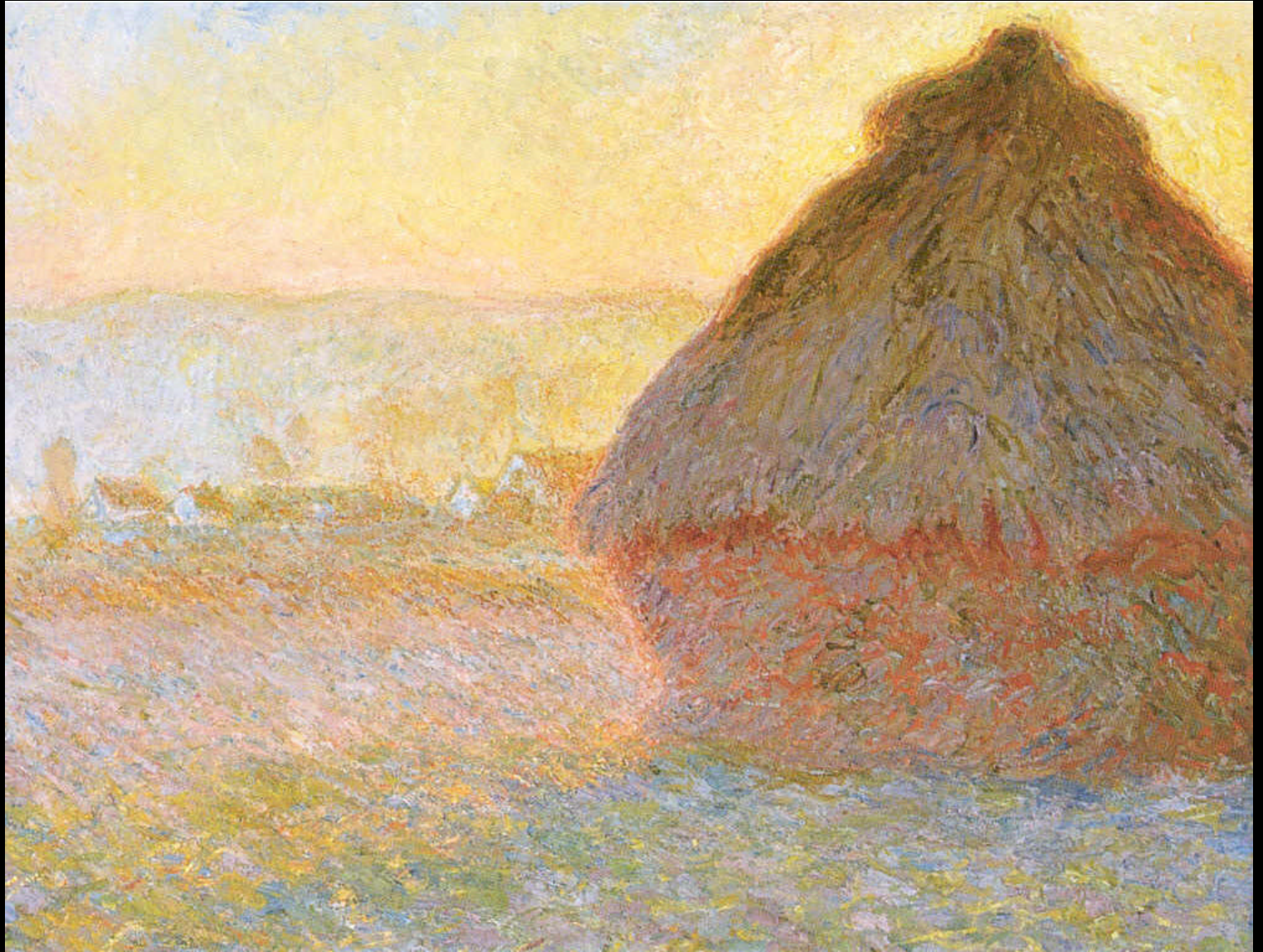
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# *Colored shadow*

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# *Shadow reveal*

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# *Shadow reveal*

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# Shadow reveal

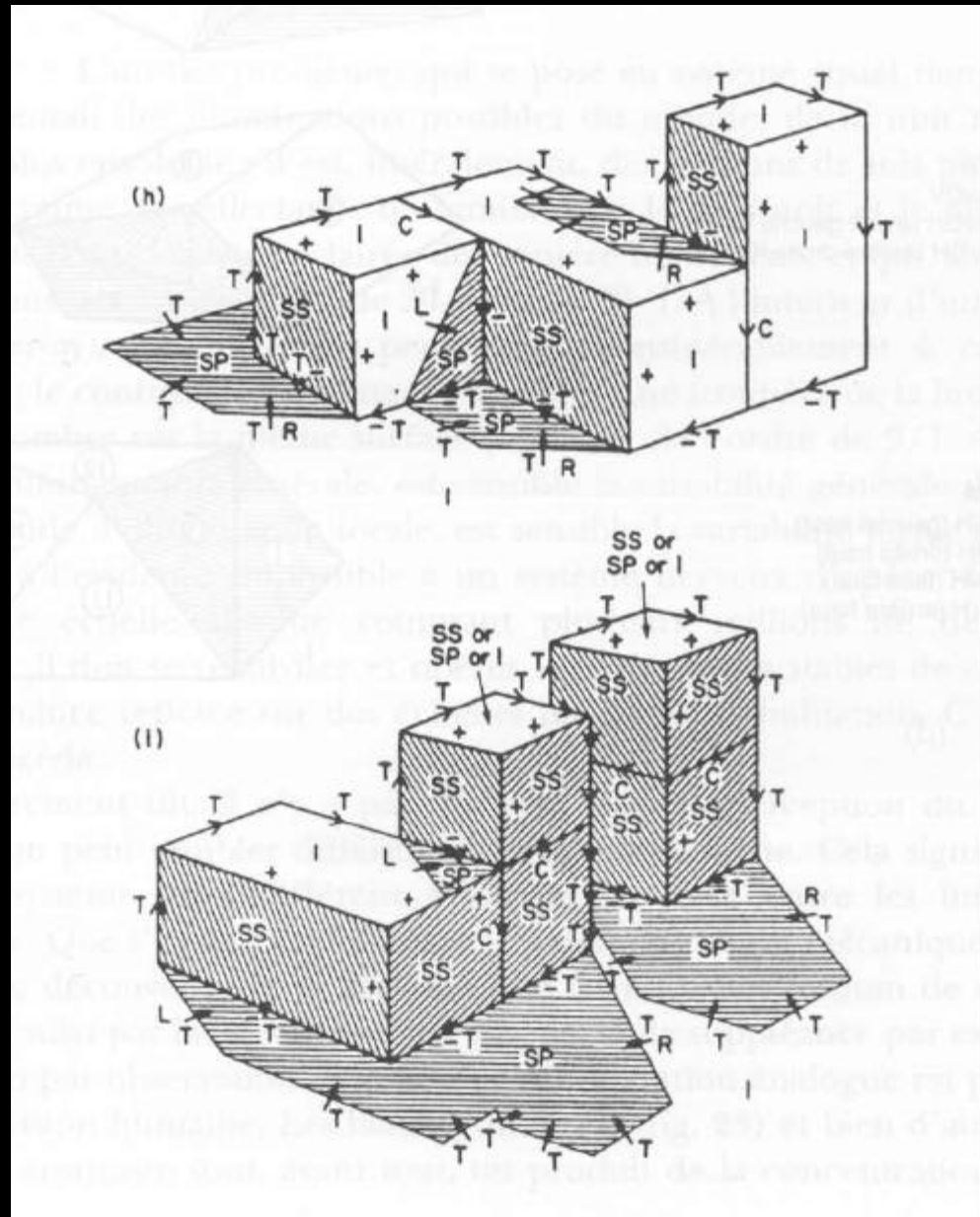


Plate 52 Grandville, *The Shadows (The French Cabinet)* from *La Caricature*, 1830.



# Shadow

- [Waltz 75]



# *Plan*

---

- Intro
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- Atmospheric perspective
- Light transfers
- Photography

# *Atmospheric perspective*

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- Saturation
- Hue
- Precision



# *Atmospheric perspective*

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- Leonardo



# *Atmospheric perspective*

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- Titian, *Bacchus*



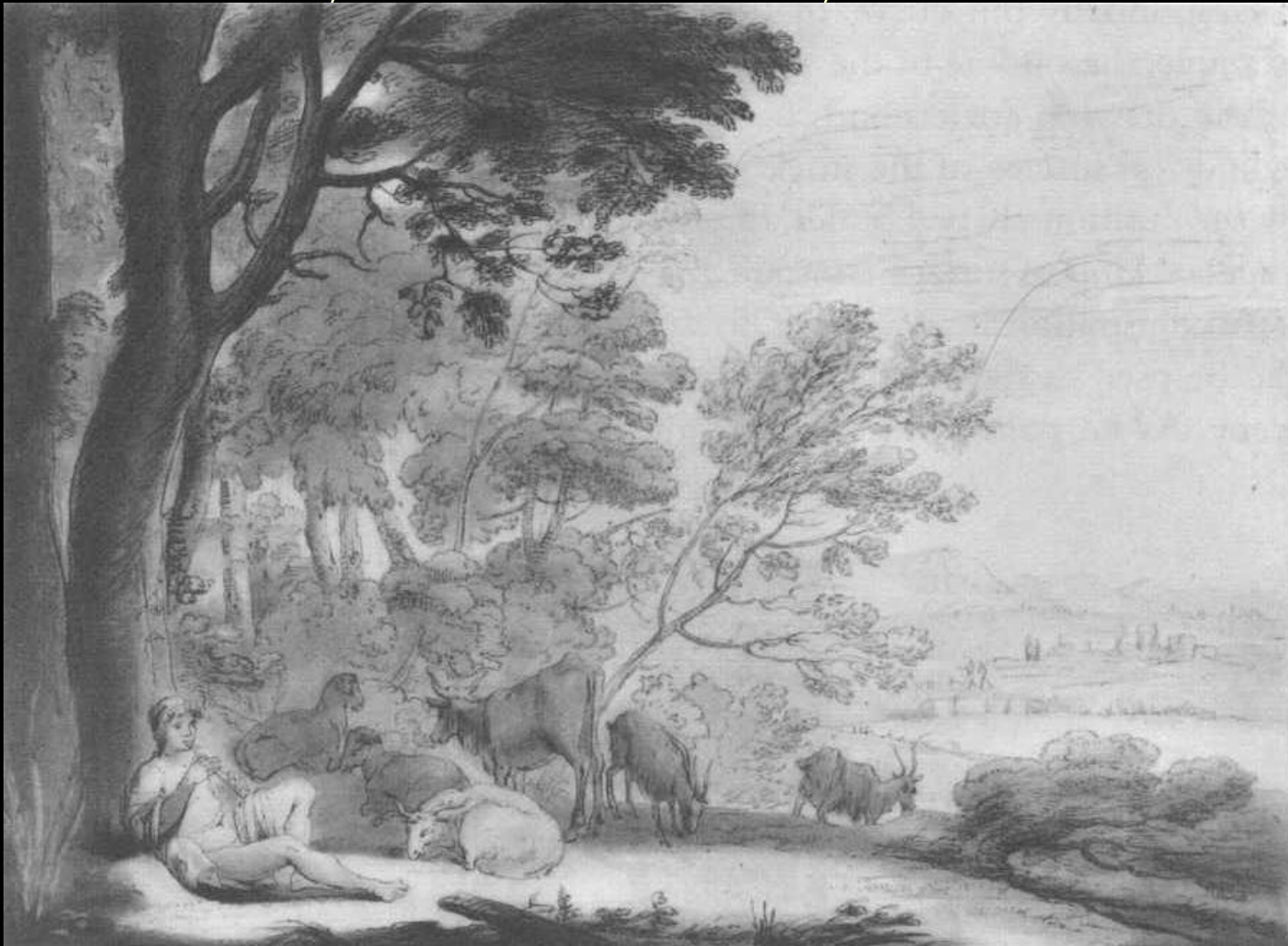
Tone & color system



# *Atmospheric perspective*

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- R. Earlom, *Pastoral Scene*, 1774



Tone & color system



# *Plan*

---

- Intro
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- Photography

# *Global illumination*

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- Light inter-reflection
- Each surface is a secondary light source
- Crucial for indoor scenes

# *Global illumination*



Tone & color system



# *Global illumination*

---



Tone & color system

# *Global illumination*

---



Rendered using the Lightscape Visualization System  
Courtesy of Isao Nagaoka and Joe Henke. Copyright (c) 1995 Digital Architecture (New York, NY).

# *Global illumination*



Tone & color system



# *Global illumination*

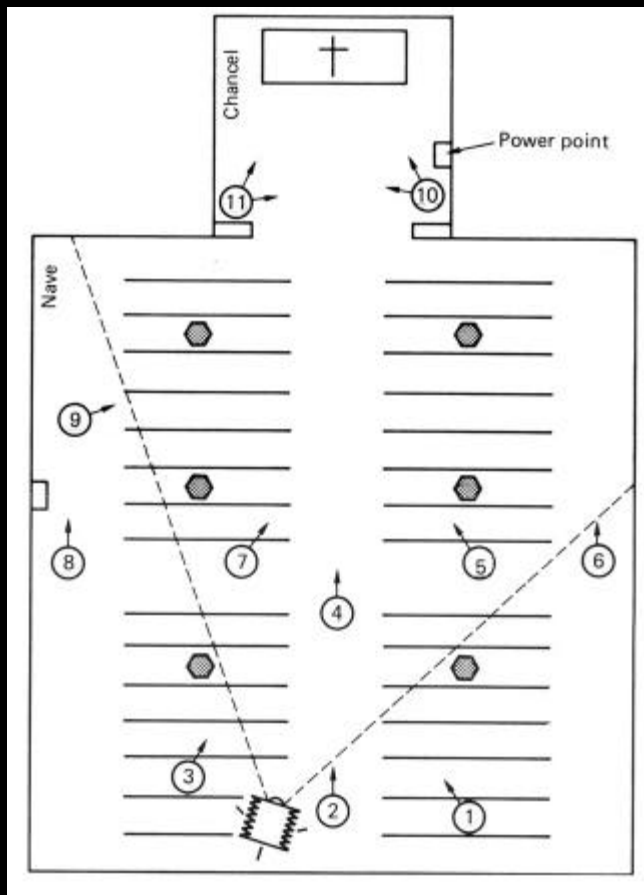
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Tone & color system



# Counter-example: painting with light



# *Global illumination & production*

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- Mostly unused
- Because artists want local control



# *Global illumination & production*

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Tone & color system

# *Plan*

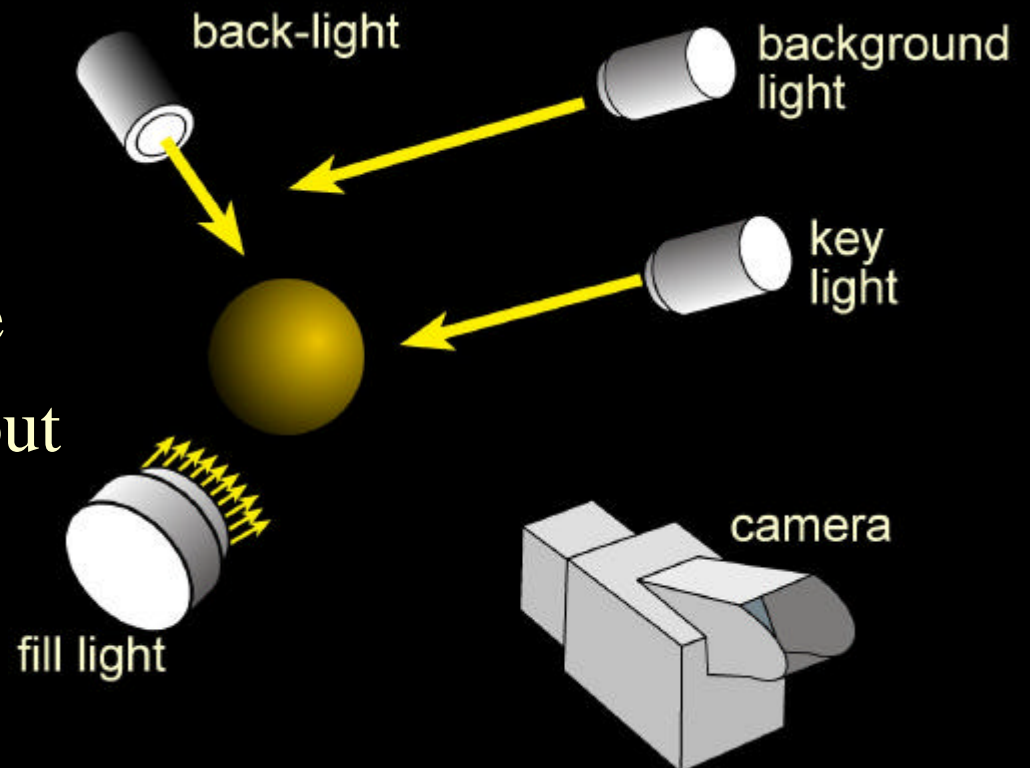
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- Intro
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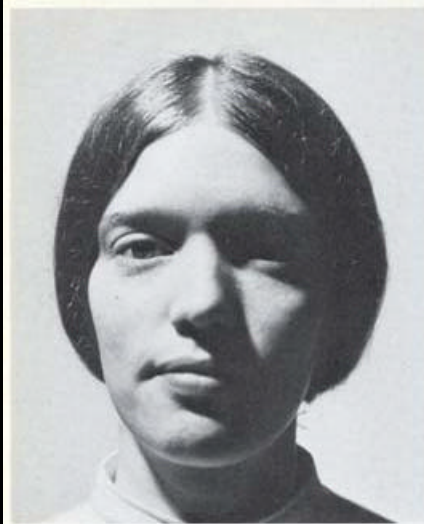


# Three Point Lighting

- Key light
  - Main and visible lighting
- Fill light
  - Fill-in shadows
- Back light
  - Emphasize silhouette
  - Make subject stand out
- Independent lighting



# Portrait lighting



Main light



Fill-in light



Accent light



Background light



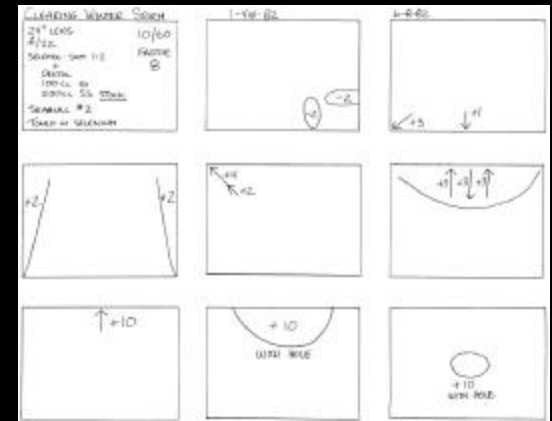
# *Filter for black and white*





# *Dodging and Burning*

- Clearing Winter Storm





# *Haze filtering*

- Haze is bluish



No filter



Blue filter



Red filter

# *Example*

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- Edgar Degas  
*Ballet Dancer  
in Position  
facing 3/4 front  
1872*



# Example

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- Tom Purvis 1935



Tone & color system