

The Art and Science of Depiction

*Limitations of the Medium,
compensation or accentuation:
Contrast & Palette*

Fredo Durand

MIT- Lab for Computer Science

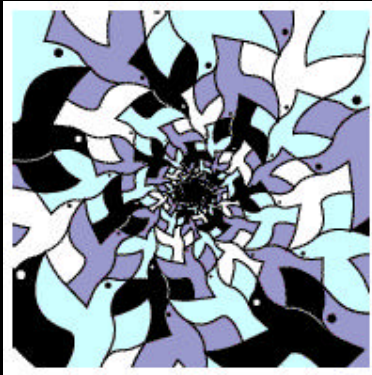
Hans Holbein

The Ambassadors



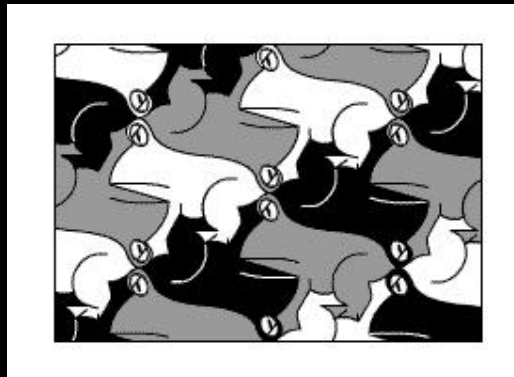
Limitations: contrast & palette

Makoto Nakamura



Limitations: contrast & palette

Makoto Nakamura



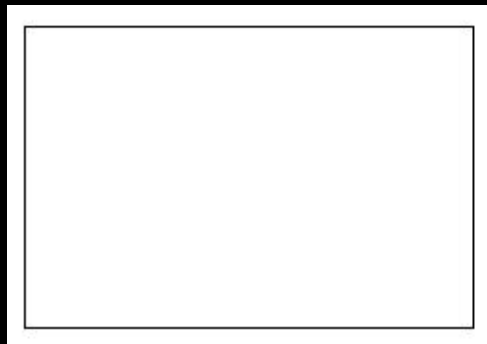
Limitations: contrast & palette

Makoto Nakamura

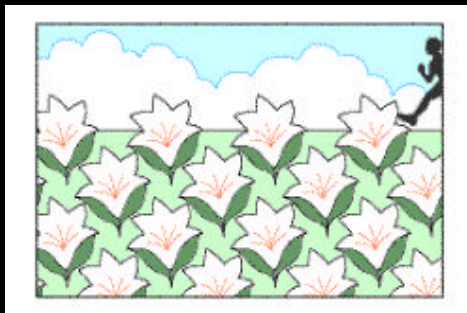


Limitations: contrast & palette

Makoto Nakamura

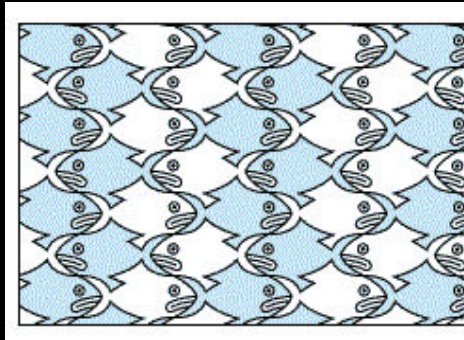


Makoto Nakamura



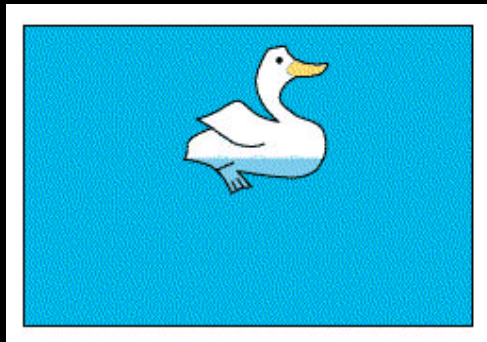
Limitations: contrast & palette

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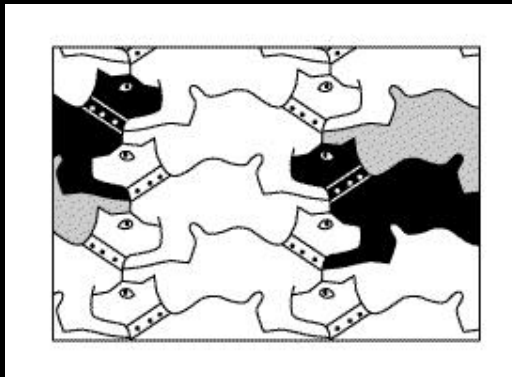


Limitations: contrast & palette

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Makoto Nakamura



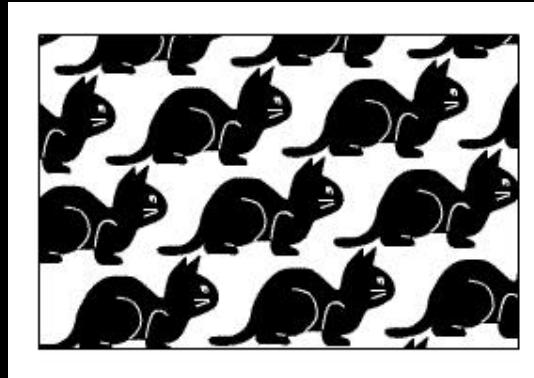
Limitations: contrast & palette

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Limitations: contrast & palette

Makoto Nakamura



Limitations: contrast & palette

Assignments for Monday 16.

- *Solso Cognition and the Visual Arts*
 - Chapter 5 & 6
- **Essay**
 - Exploratory or Picture comment
 - Choose subject
 - Outline of the issues

Personal Meeting II

- Class
- Essay
- Project

Plan

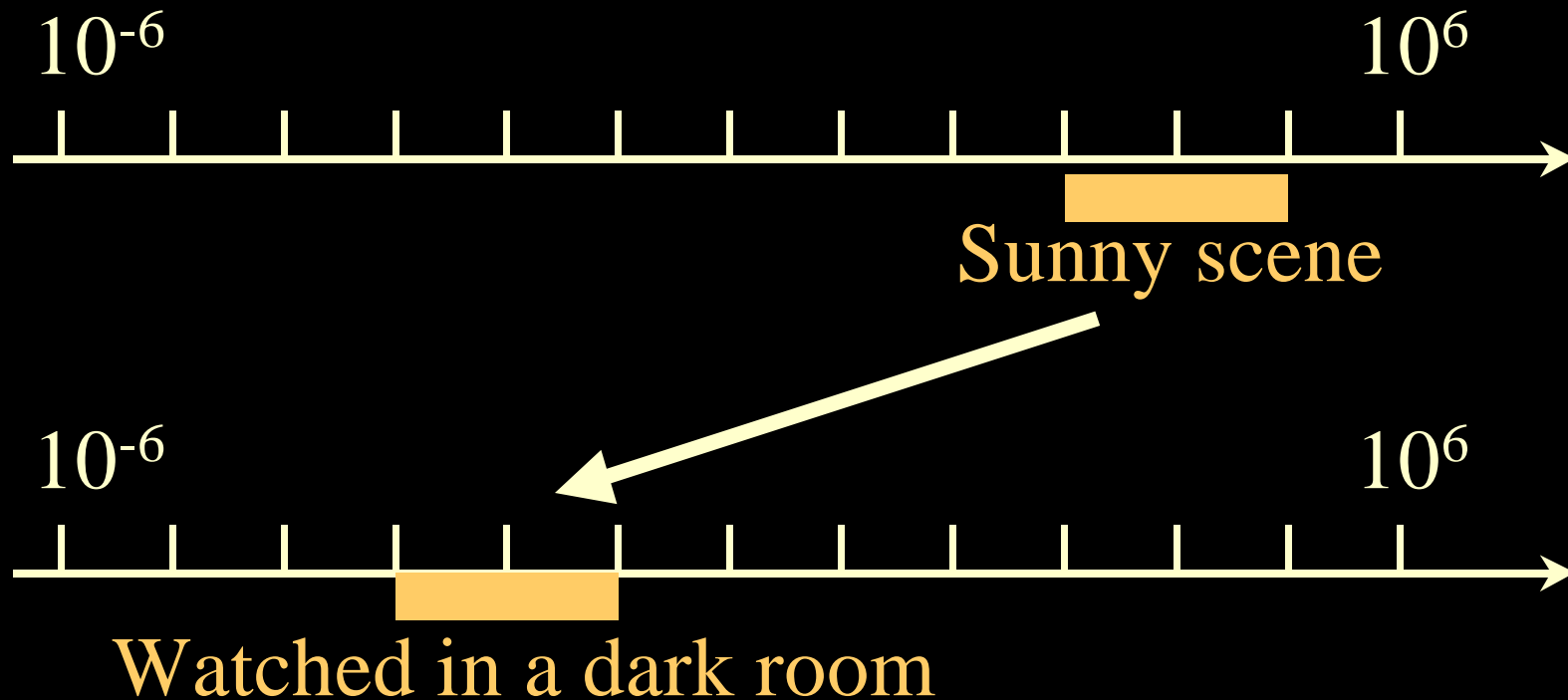
- The picture is flat
- The viewpoint is unique
- The image is finite, it has a frame
- The picture is static
- The contrast is limited

Context

- Real world: 10^{-6} to 10^6 cd/m²
- Picture
 - Max contrast 1:500
 - Typically 1:50

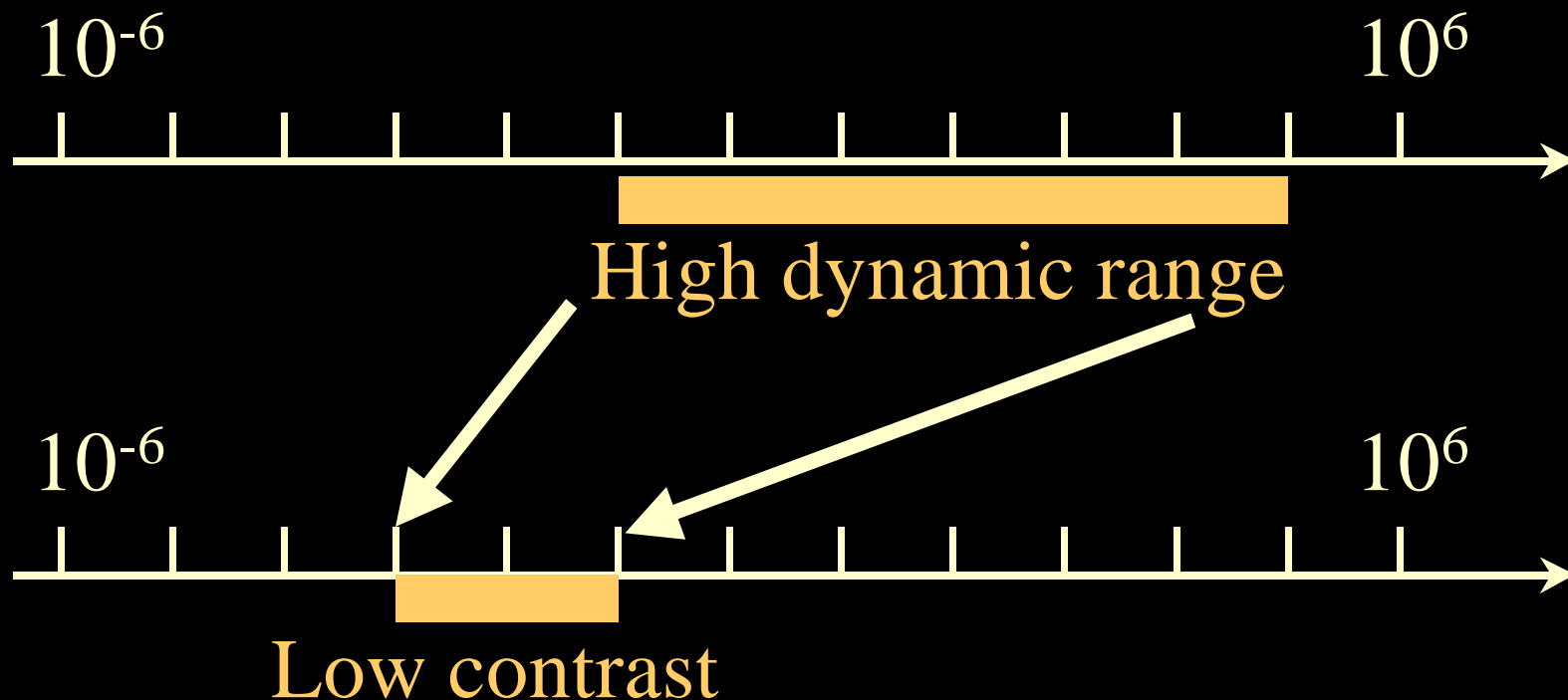
Two problems

- The image intensity does not match the real conditions



Two problems

- The image intensity does not match the real conditions
- The contrast is not sufficient



Three contexts

- Photo
- Computer Graphics
- Painting and drawing

The limit of illusion

- Pozzo's ceiling: the Sky is not bright enough



Limitations: contrast & palette

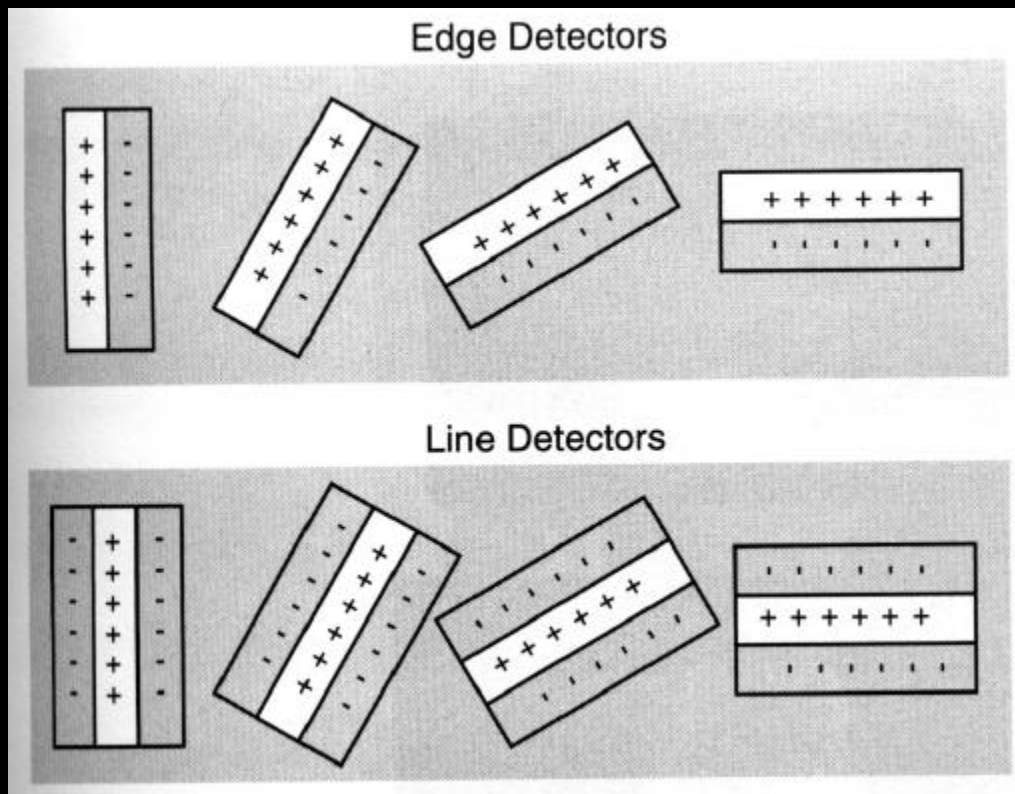
The limit of illusion

- Bruneleschi's experiment
 - Used a mirror for the sky



Edge detection

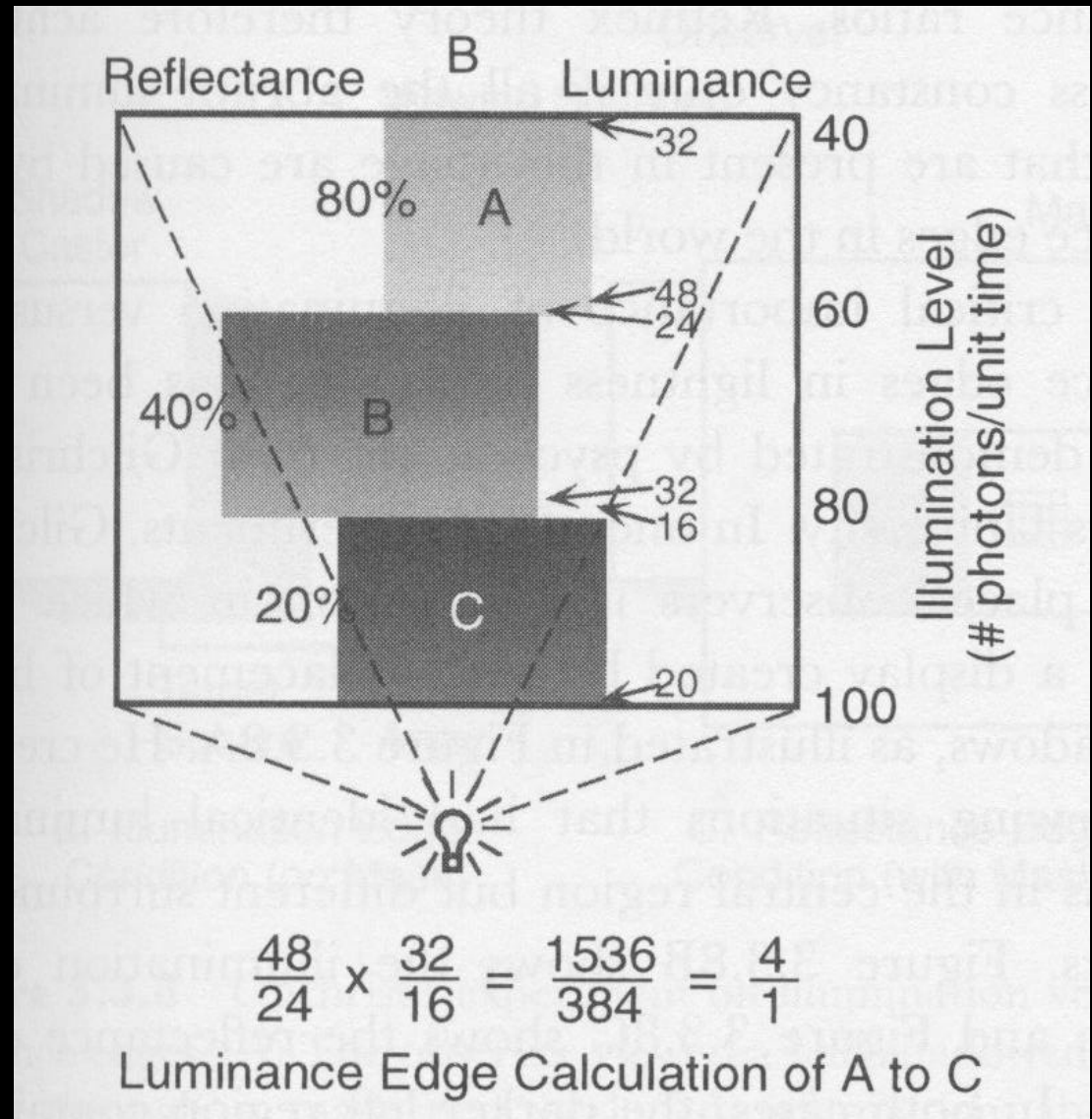
- Similar to center-surround
- Measured using micro-electrodes



Limitations: contrast & palette

Land Retinex

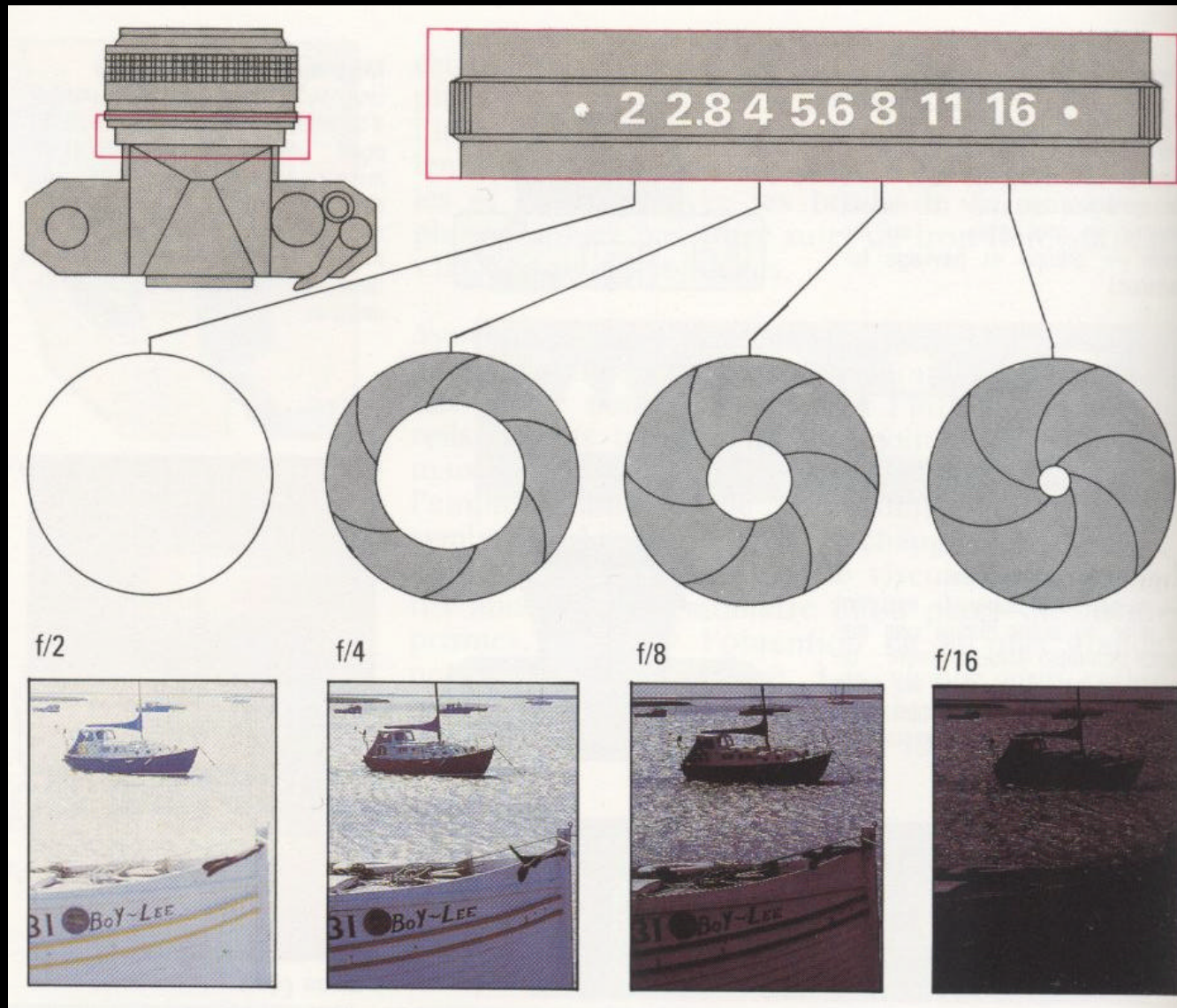
- Local contrast



Plan

- Problem 1: intensity does not match
 - Exposure
 - Viewing conditions
 - Night scenes
- Problem2: insufficient contrast
 - Tone Reproduction
 - Lighting
 - Tone mapping in CG
 - Flares
 - Painting

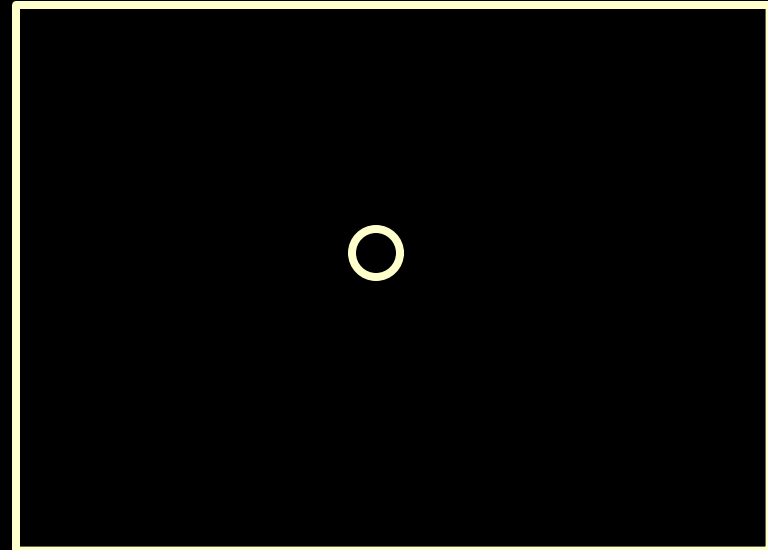
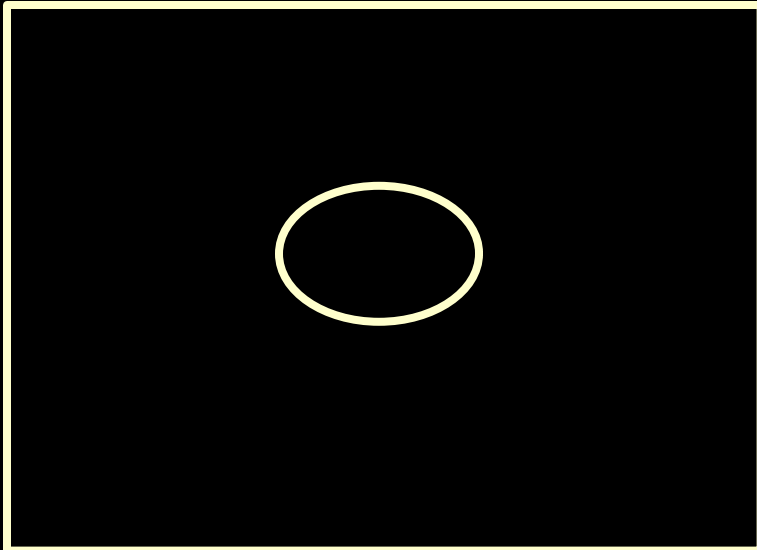
Photo exposure



Limitations: contrast & palette

Metering

- Centered average
- Spot
- Incident
 - Measure incoming light



Nikon 3D Color Matrix

- Database of 30,000 photos
- Multiple captors (segments)
- Exposure depends on
 - Brightness from each segments
 - Color
 - Contrast
 - Distance
 - Focus (where is the subject)

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Hunt and Stevens effect

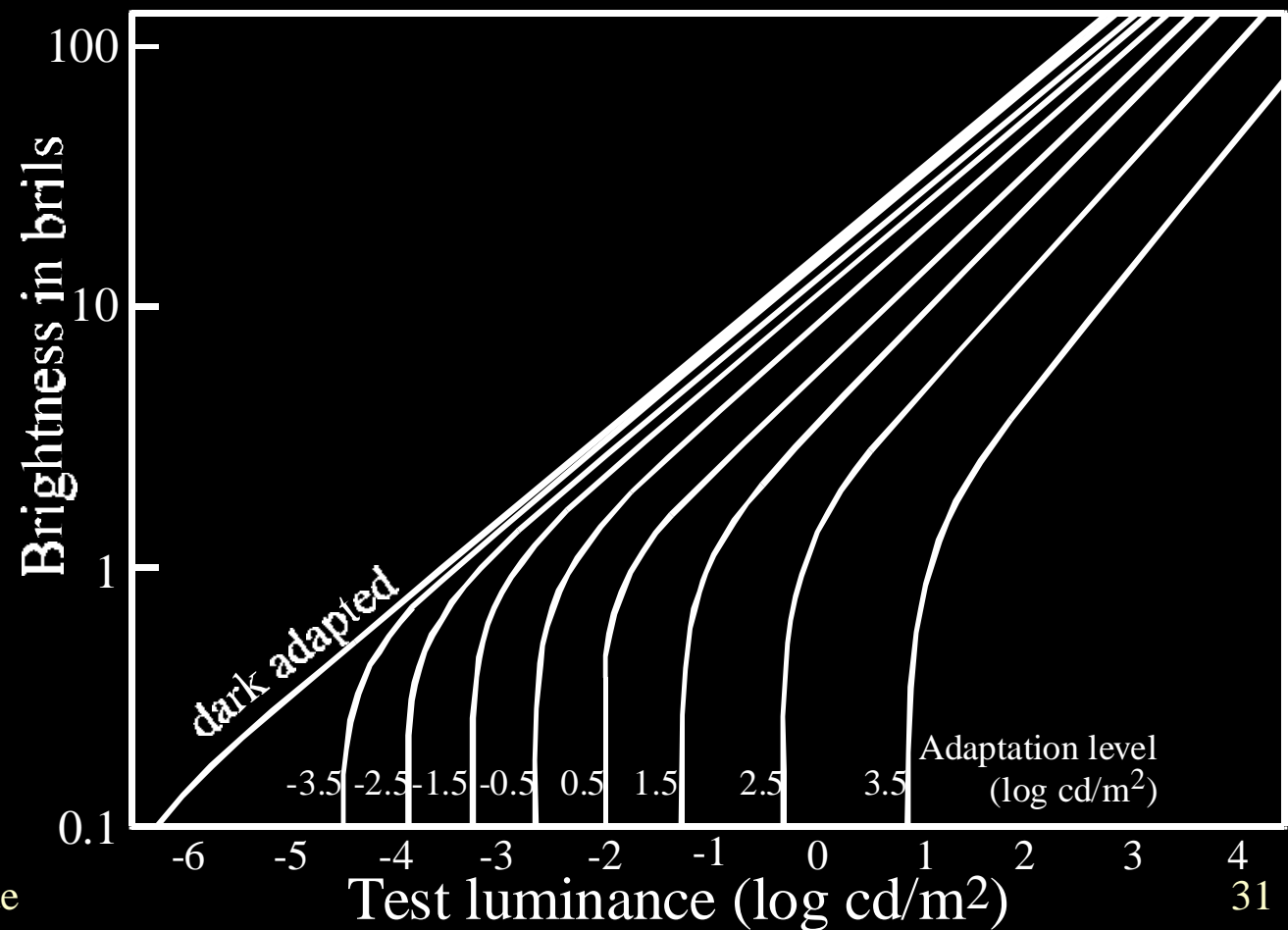
- Stevens effect
 - Contrast increases with luminance

Hunt and Stevens effect

- Stevens effect
 - Contrast increases with luminance
- Bartleson-Breneman effect
 - Image contrast changes with surround
 - A dark surround decreases contrast
(make the black of the image look less deep)
- Hunt effect
 - Colorfulness increases with luminance
- Hence the need for gamma correction

Suprathreshold

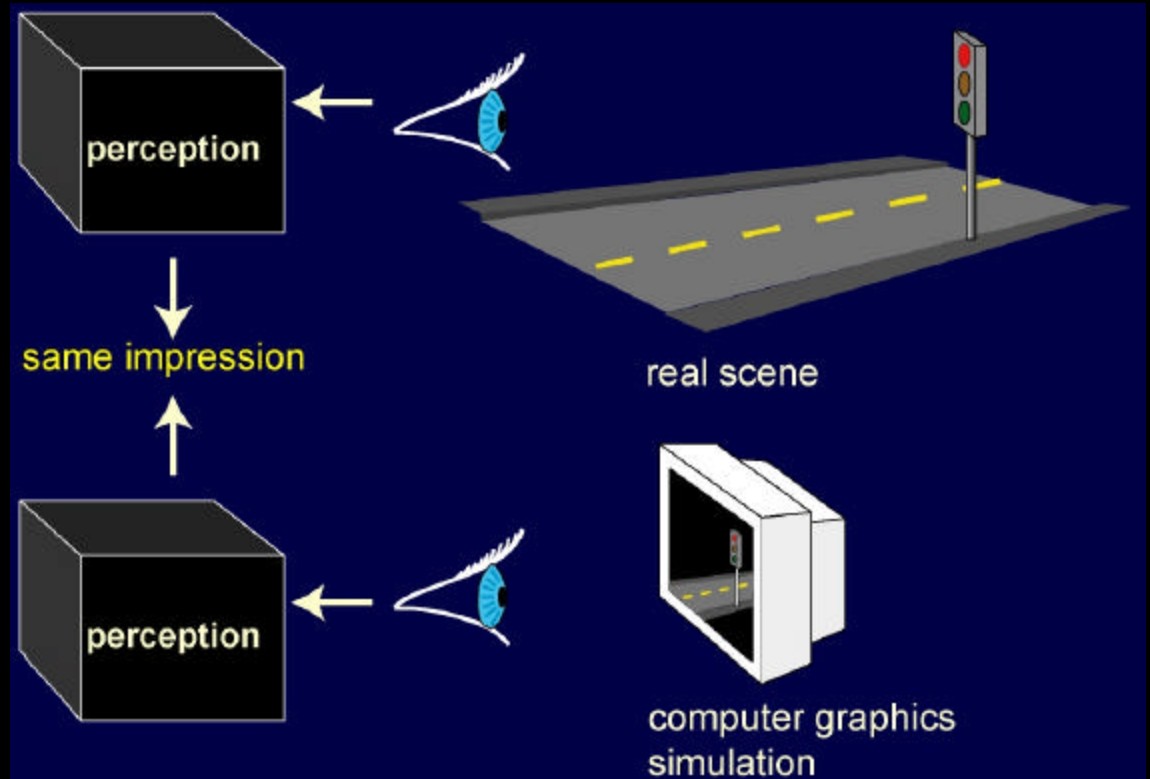
- Subjective brightness
- Power law
- Exponent
 - 0.33 to 0.5
- Gamma correction



Limitations: contrast & palette

Tone mapping

- Real scene: large range of luminance
 - (from 10^{-6} to 10^6 cd/m²)
- Limitation of the display
 - 1-100 cd/m²
- Goal:
Reproduce
a faithful
impression



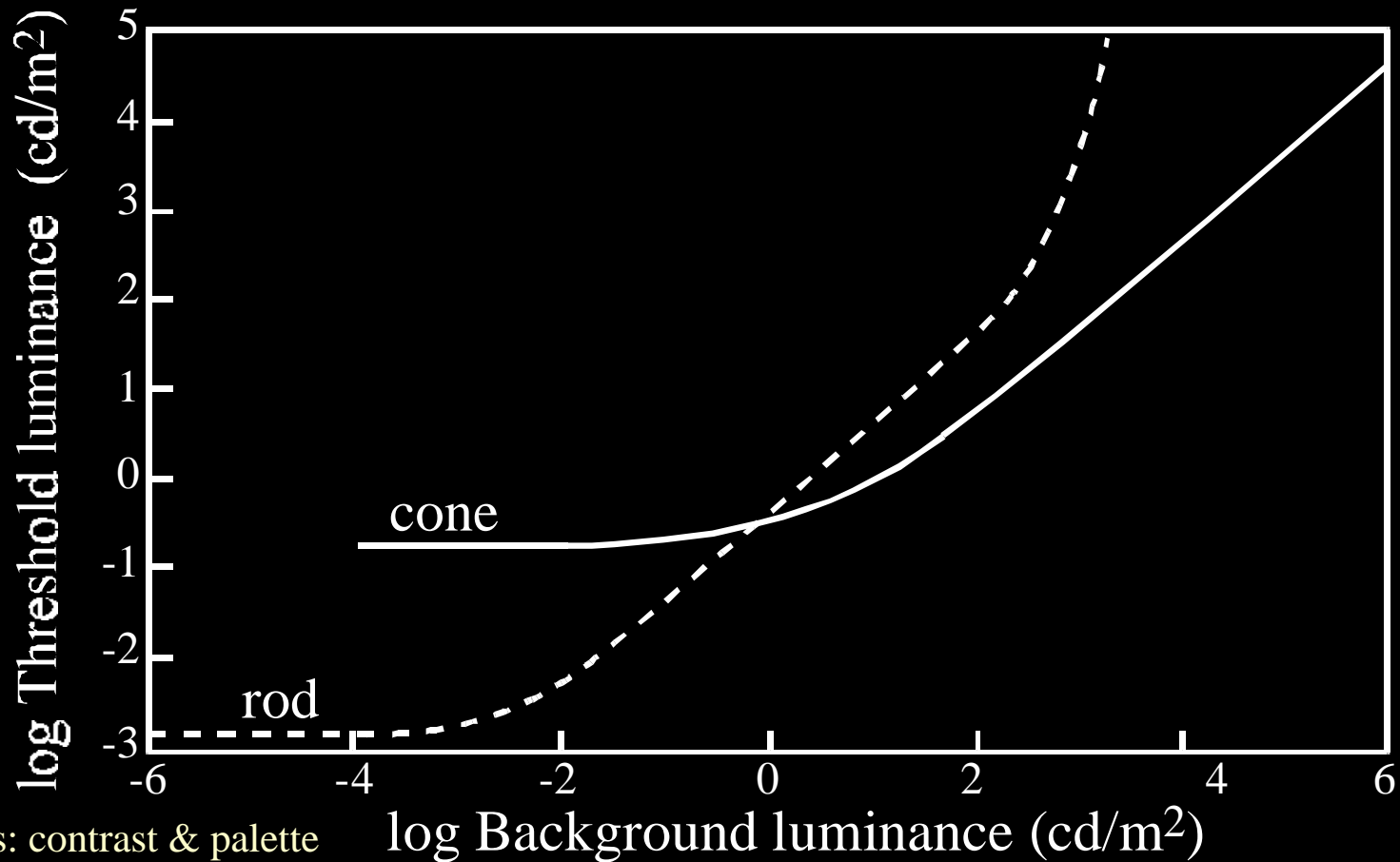
Limitations: contrast & palette

Perceptual tone mapping

- [Ferwerda et al. 1996]
- Match the smallest perceptible intensity in the simulated scene and in the display condition
- Rod and cone vision

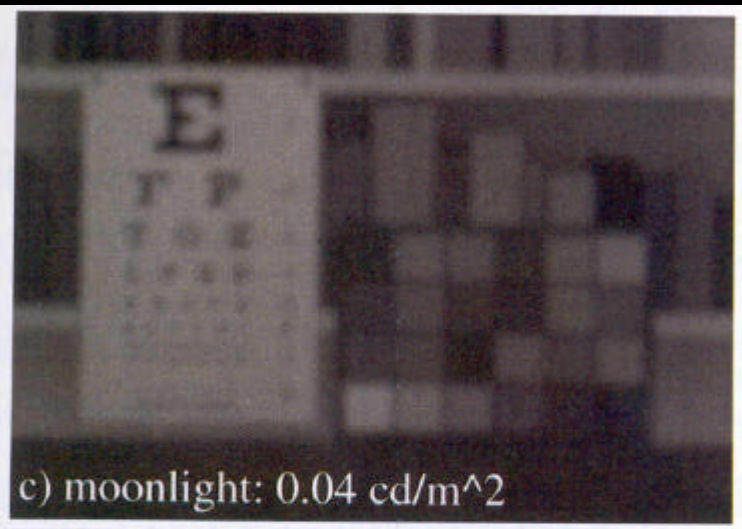
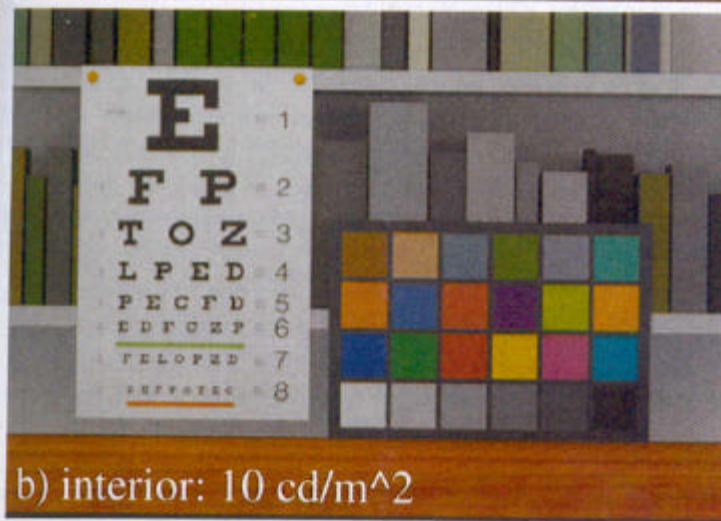
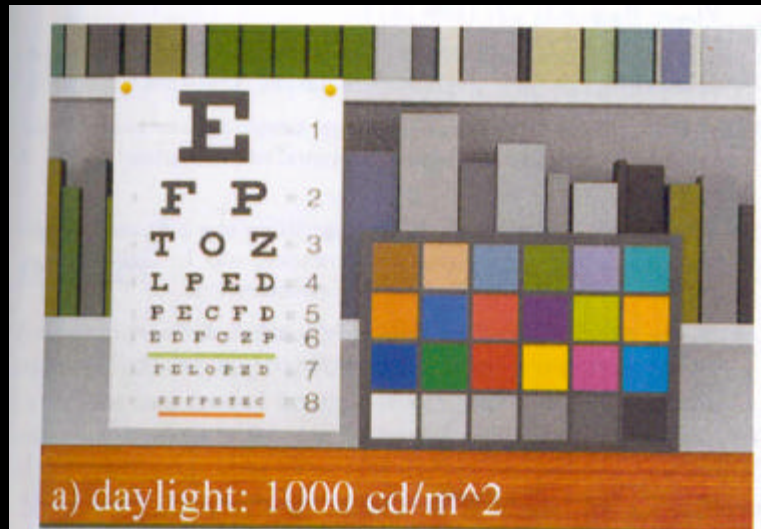
Threshold

- Smallest perceptible stimulus
- Smallest perceptible stimulus difference



Perceptual tone mapping

- [Ferwerda et al. 1996]



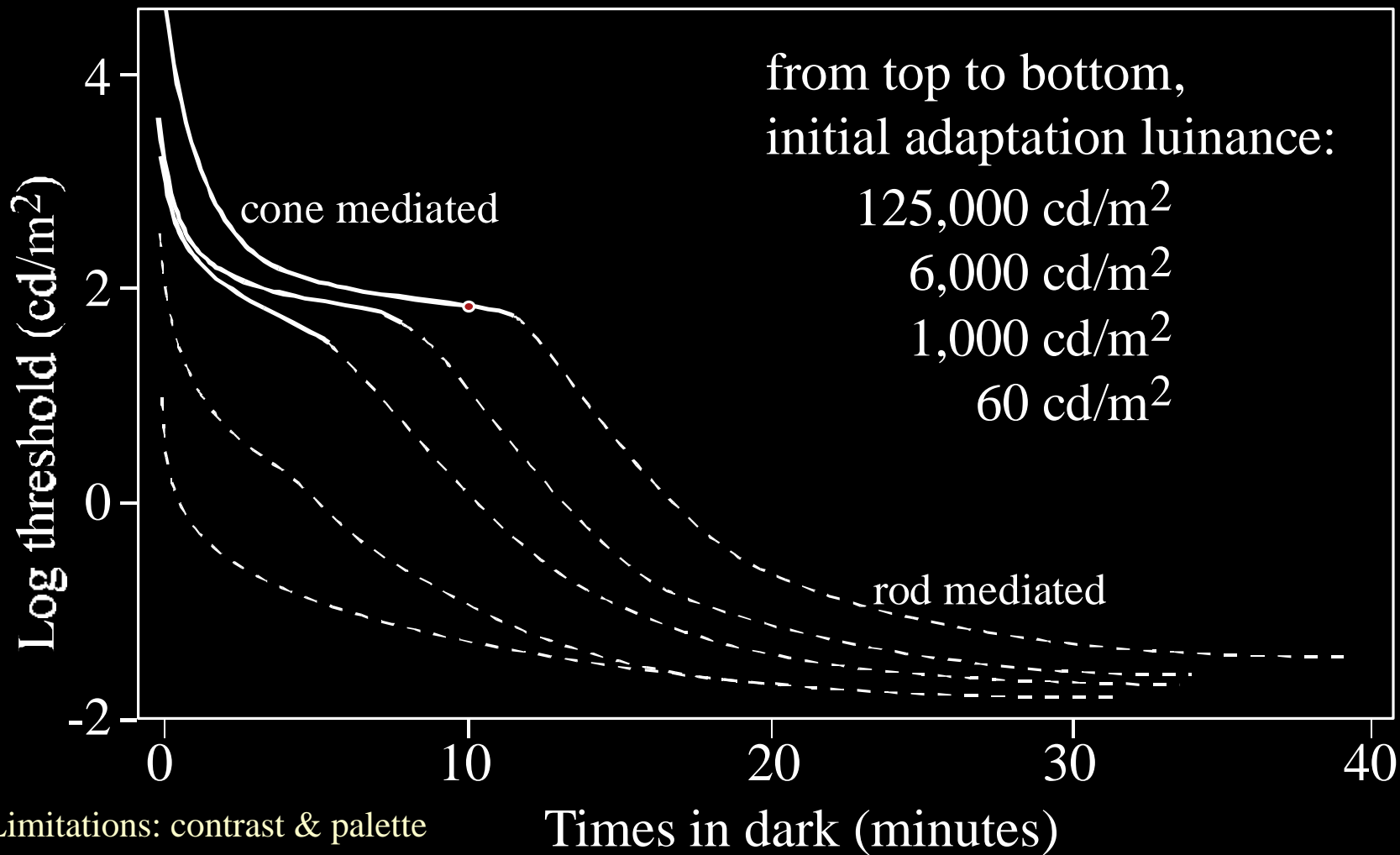
Limitations: contrast & palette

Time-dependent tone mapping

- Dazzling
- Slow dark adaptation

Dark adaptation

- Slow recovery after dramatic decrement



Time-dependent tone mapping



Limitations: contrast & palette

Plan

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Representing night scenes

- Rods, no color vision
- Blue shift
- Lower acuity
- Unable to adapt in shadows

Representing night scenes

- Pissarro, Montmartre



Limitations: contrast & palette

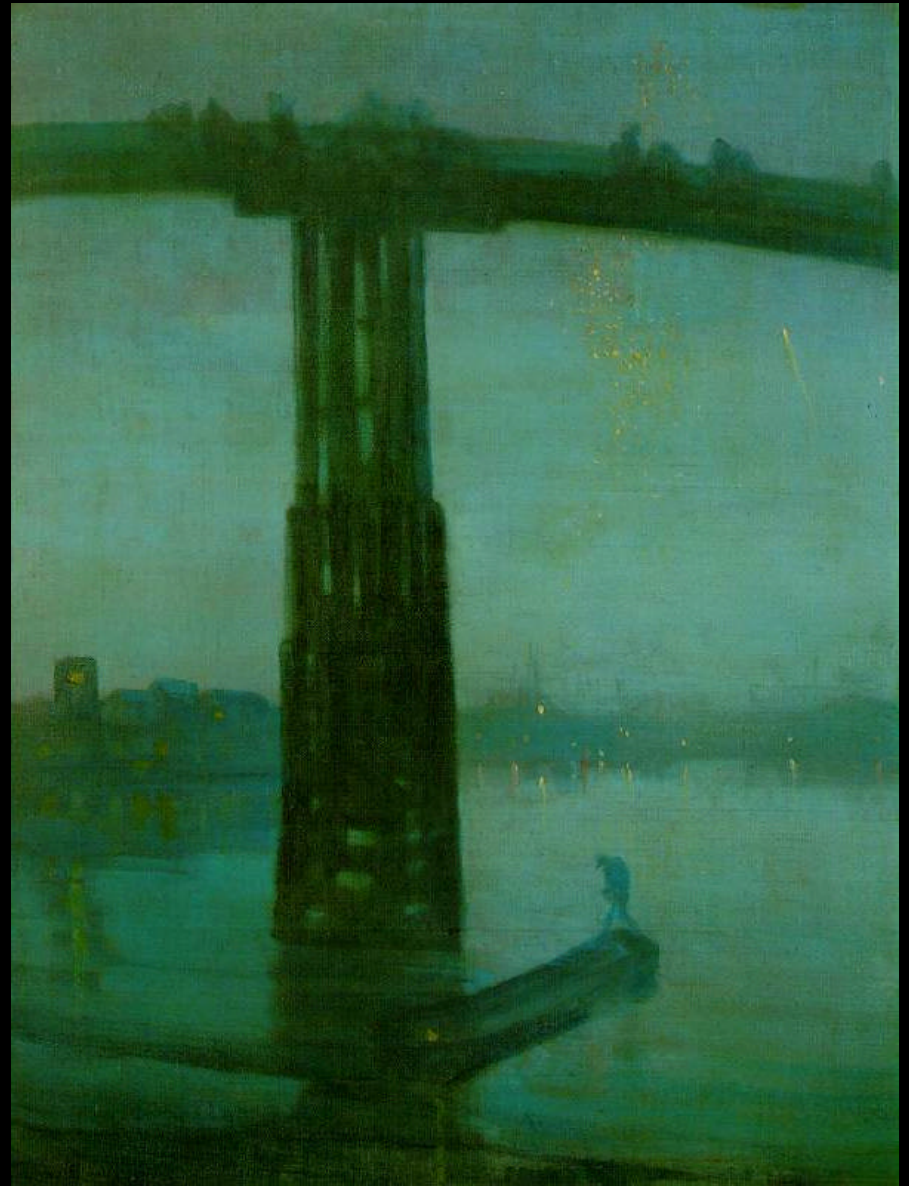
Representing night scenes

- James Abbott Mc Neil Whistler
Nocturne in Blue And Silver The Lagoon Venice
1879-1880



Representing night scenes

- Whistler,
Old Battersea Bridge



Limitations: contrast & palette

Representing night scenes

- Archibald J. Motley Jr, *Gettin' Religion* 1948



Limitations: contrast & palette

Night scenes in the movies

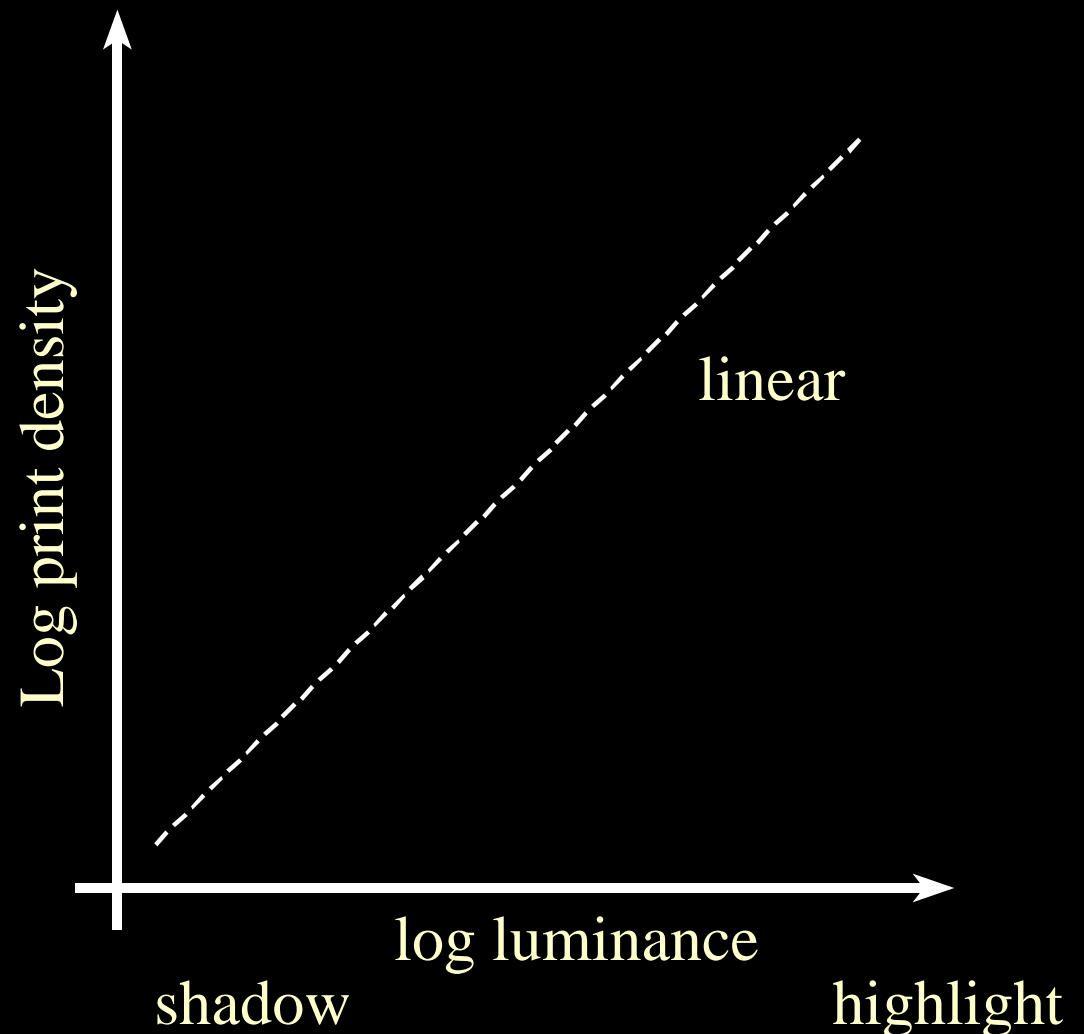
- Often *Day for night*
- Film during the day
- Few fill light (dark shadows)
- Add blue cast
- Avoid the sky

Plan

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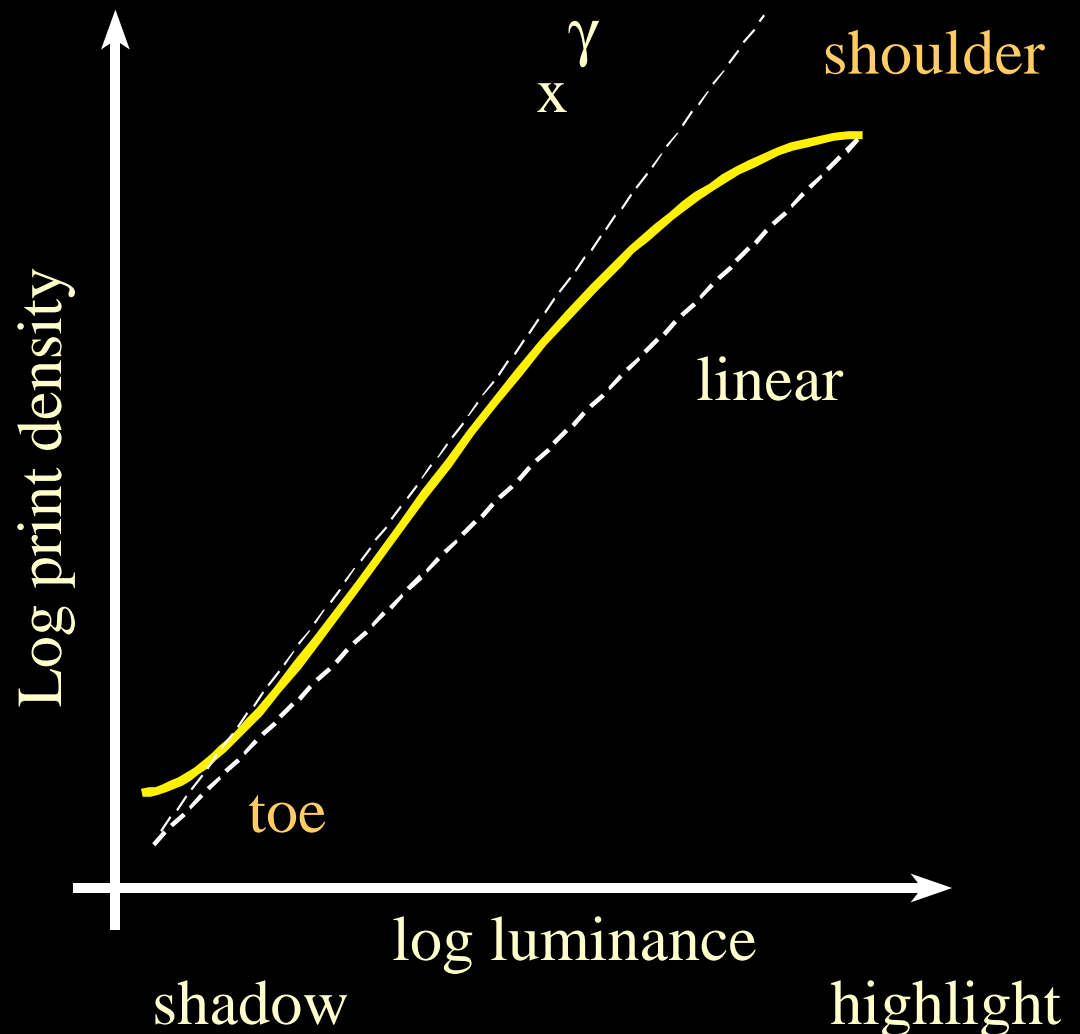
Tone Reproduction

- Not linear



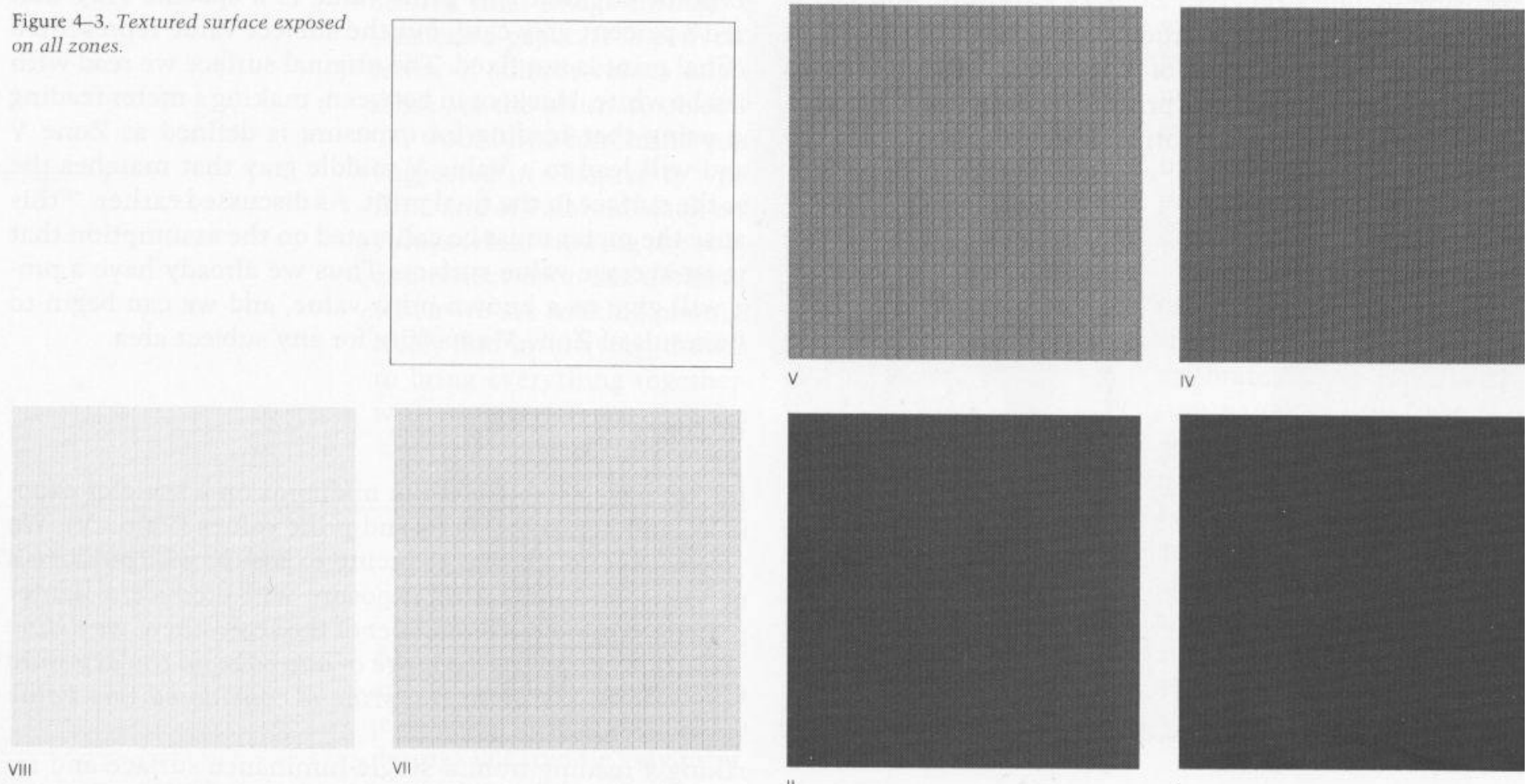
Tone Reproduction

- Not linear
- Gamma correction



Texture and contrast

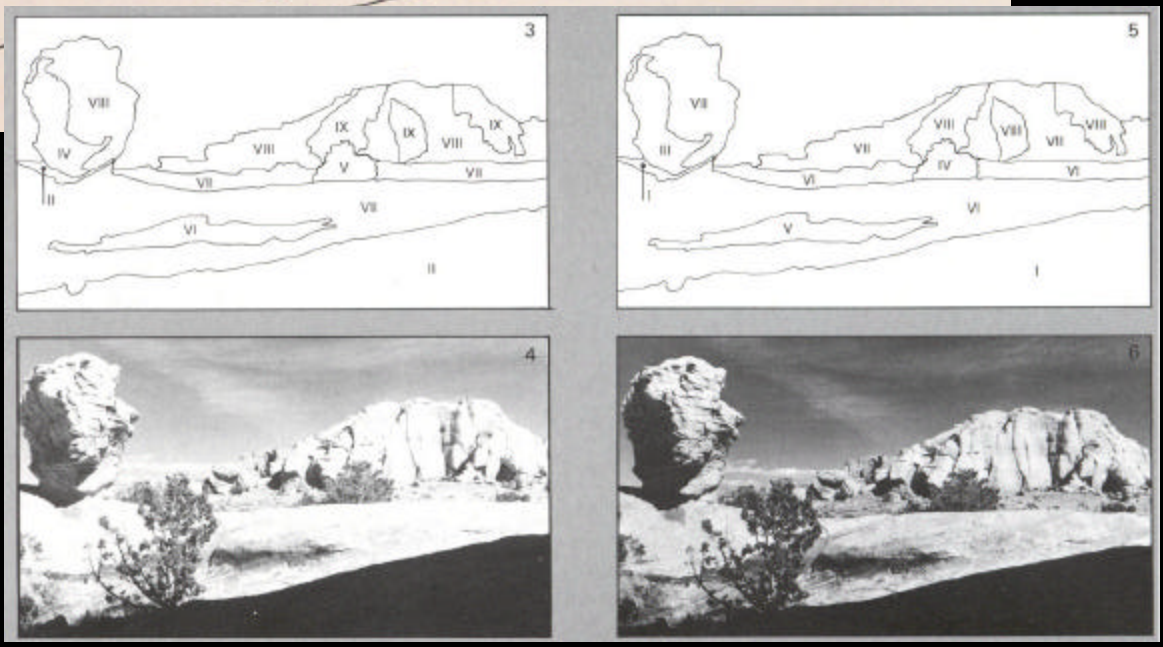
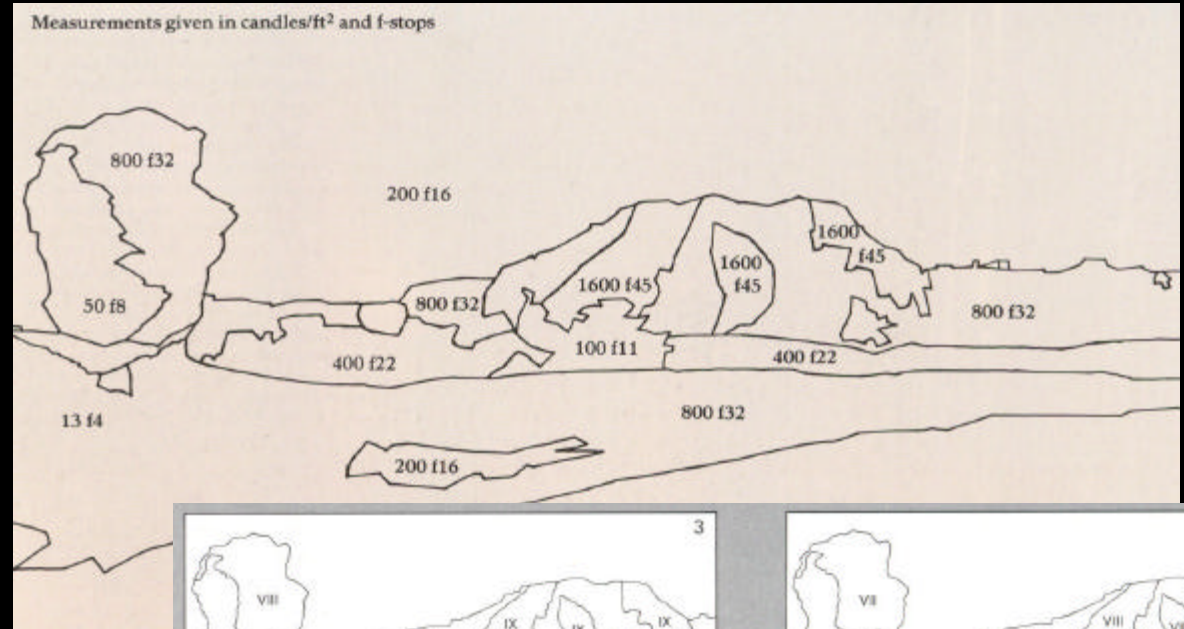
Figure 4-3. Textured surface exposed on all zones.



The Zone System

The Zones

- 0** Solid black; the same as the film rebate
- I** Nearly black; just different from Zone 0
- II** The first hint of texture
- III** Textured shadow; the first recognizable shadow detail
- IV** Average shadow value on Caucasian skin, foliage and buildings
- V** Middle grey: the pivot value; light foliage, dark skin
- VI** Caucasian skin, textured light grey; shadow on snow
- VII** Light skin; bright areas with texture, such as snow in low sunlight
- VIII** Highest zone with any texture
- IX** Pure untextured white

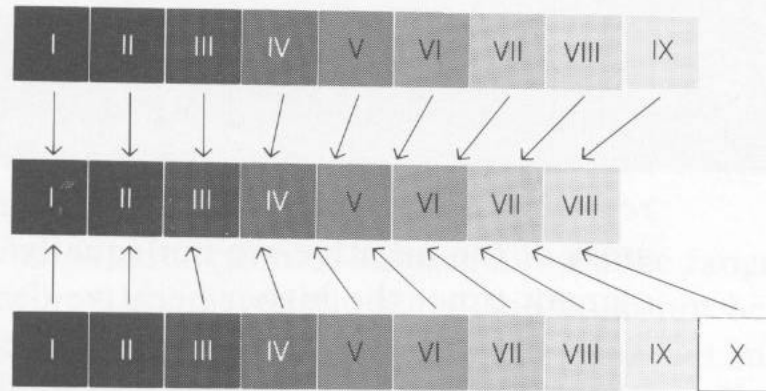


Expansion and contraction

Value Range

Development

Contraction
(less-than-normal development)

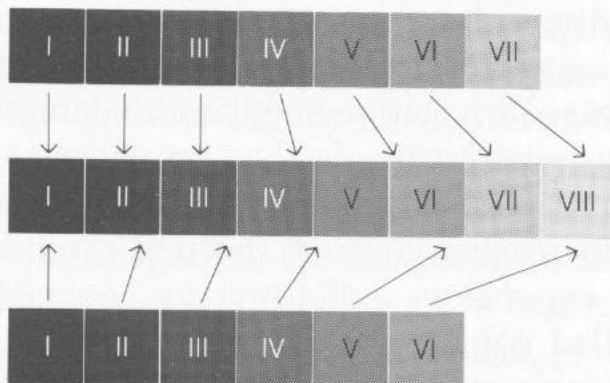


N-1

Normal

N-2

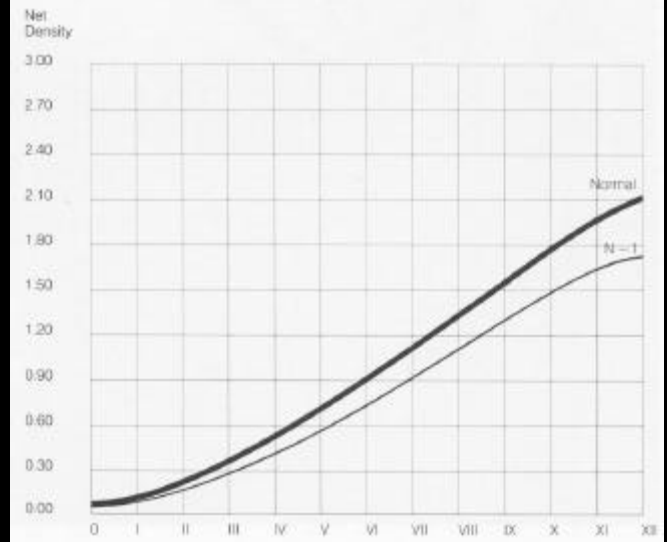
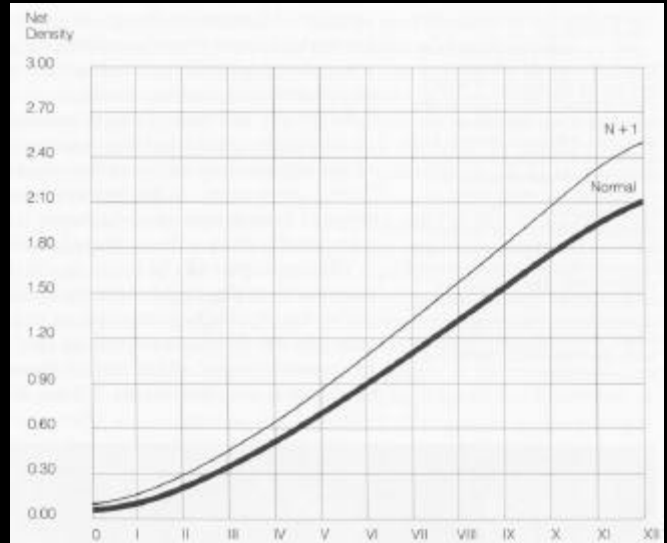
Expansion
(more-than-normal development)



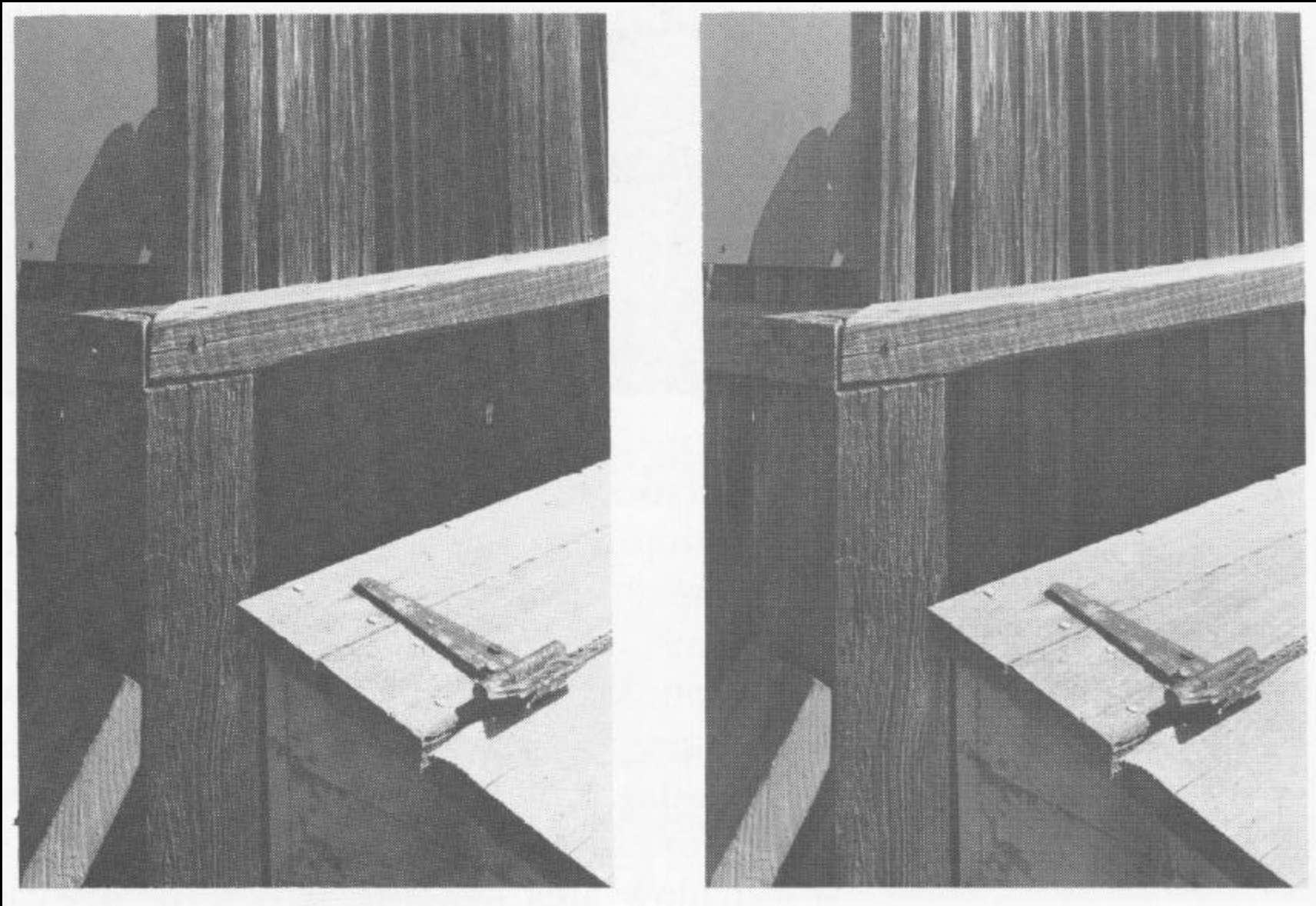
N + 1

Normal

N + 2



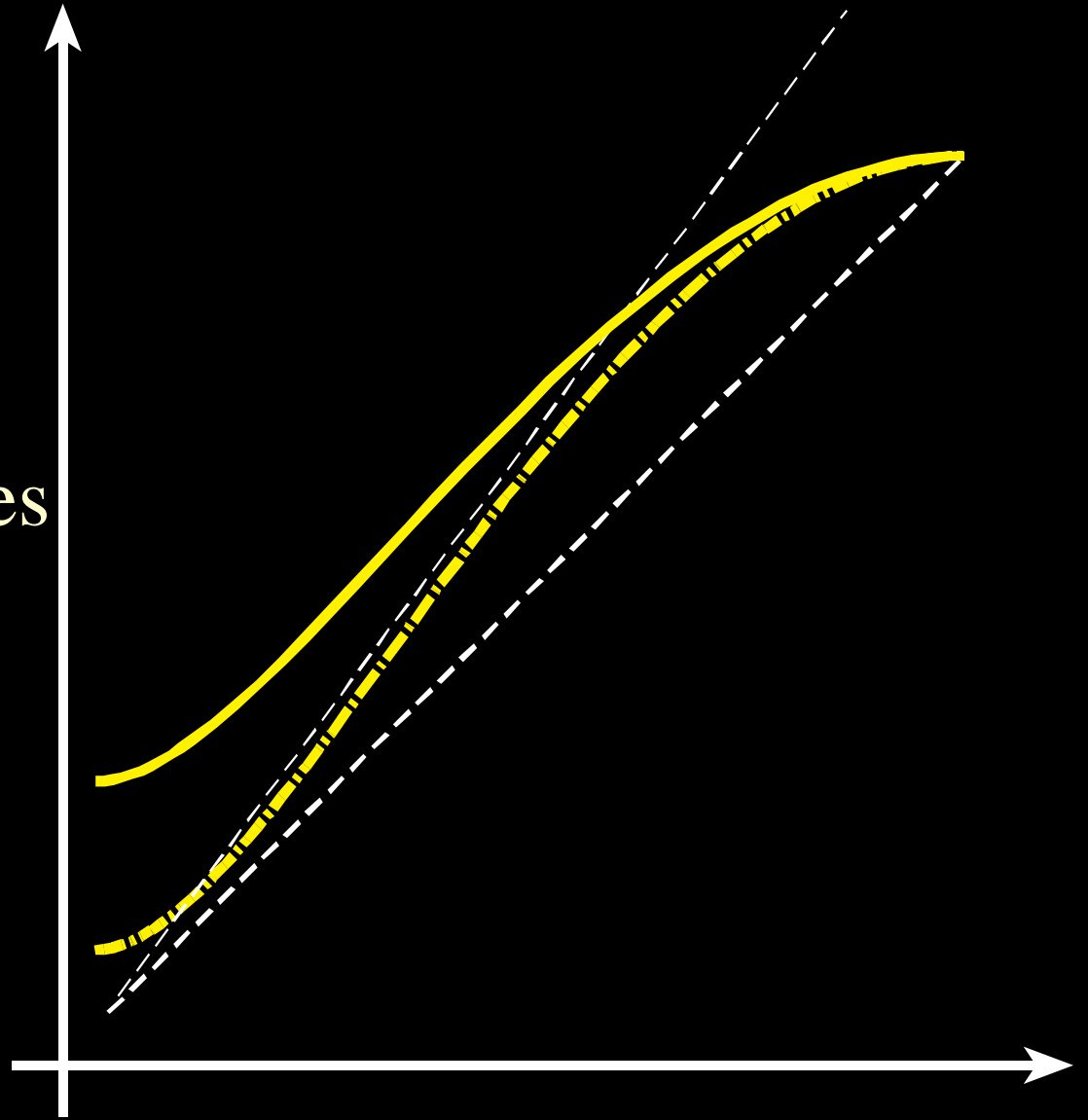
Contraction



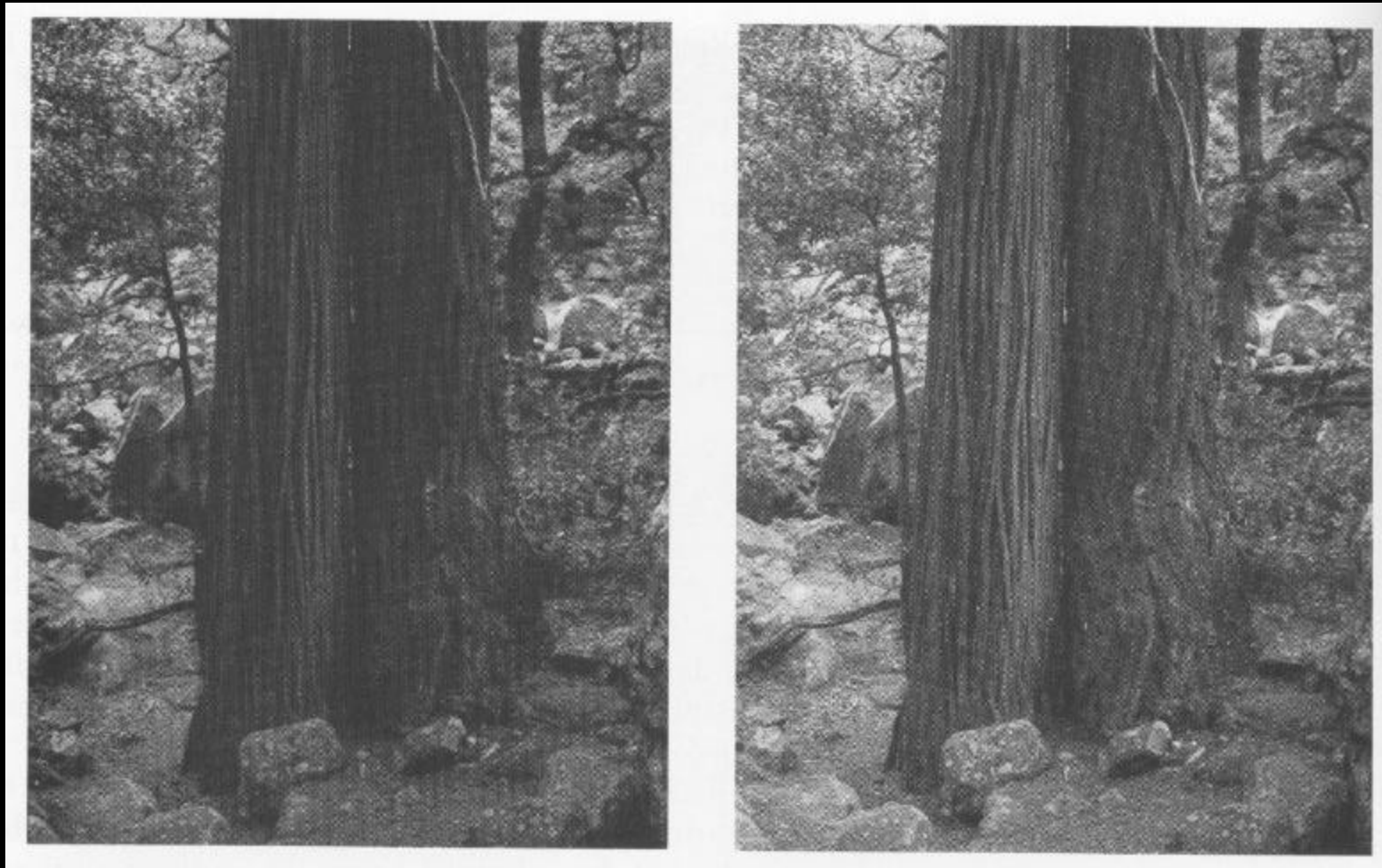
Limitations: contrast & palette

Pre-exposure

- Expose with uniform white before taking the photo
- Raise the dark tones



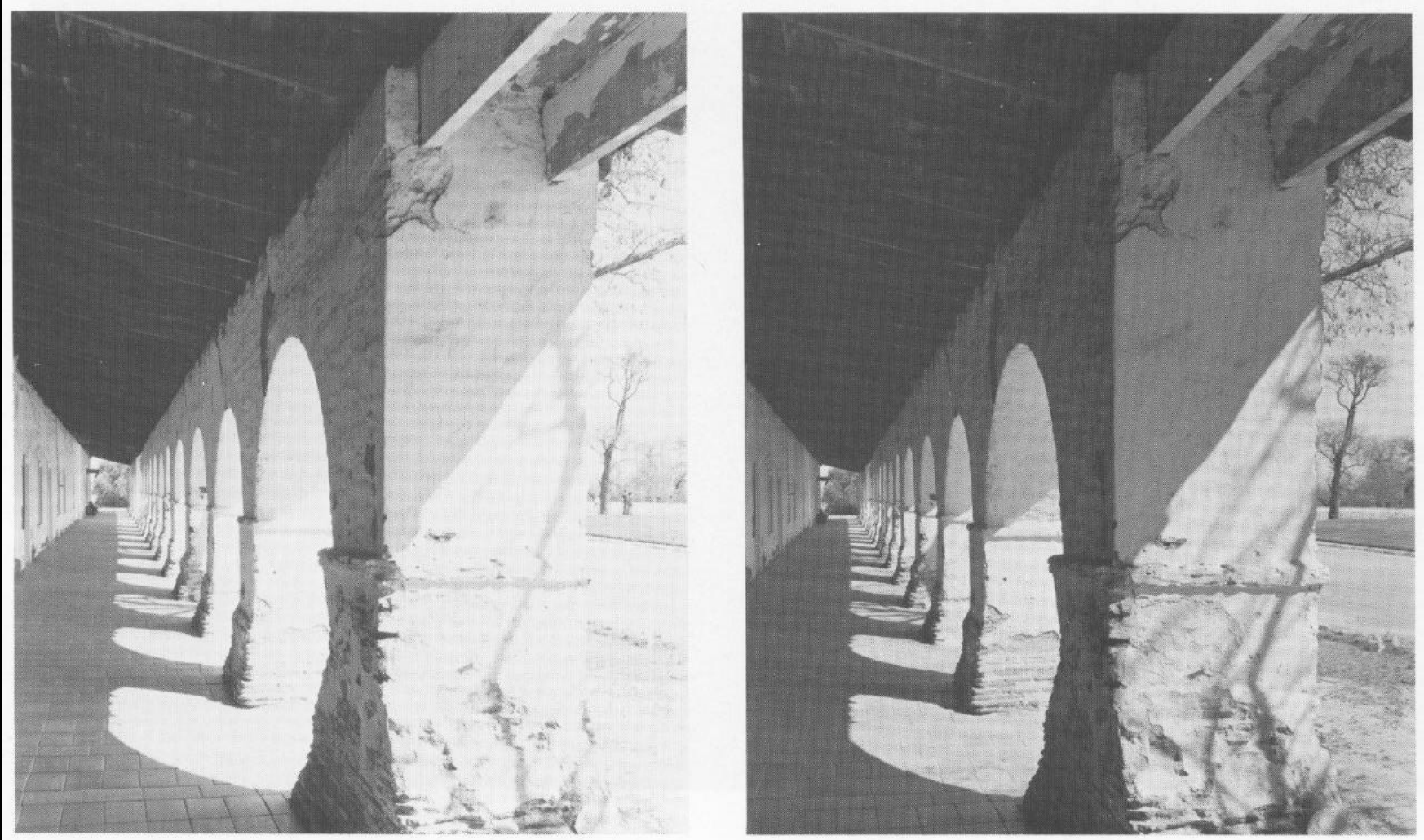
Pre-exposure



Limitations: contrast & palette

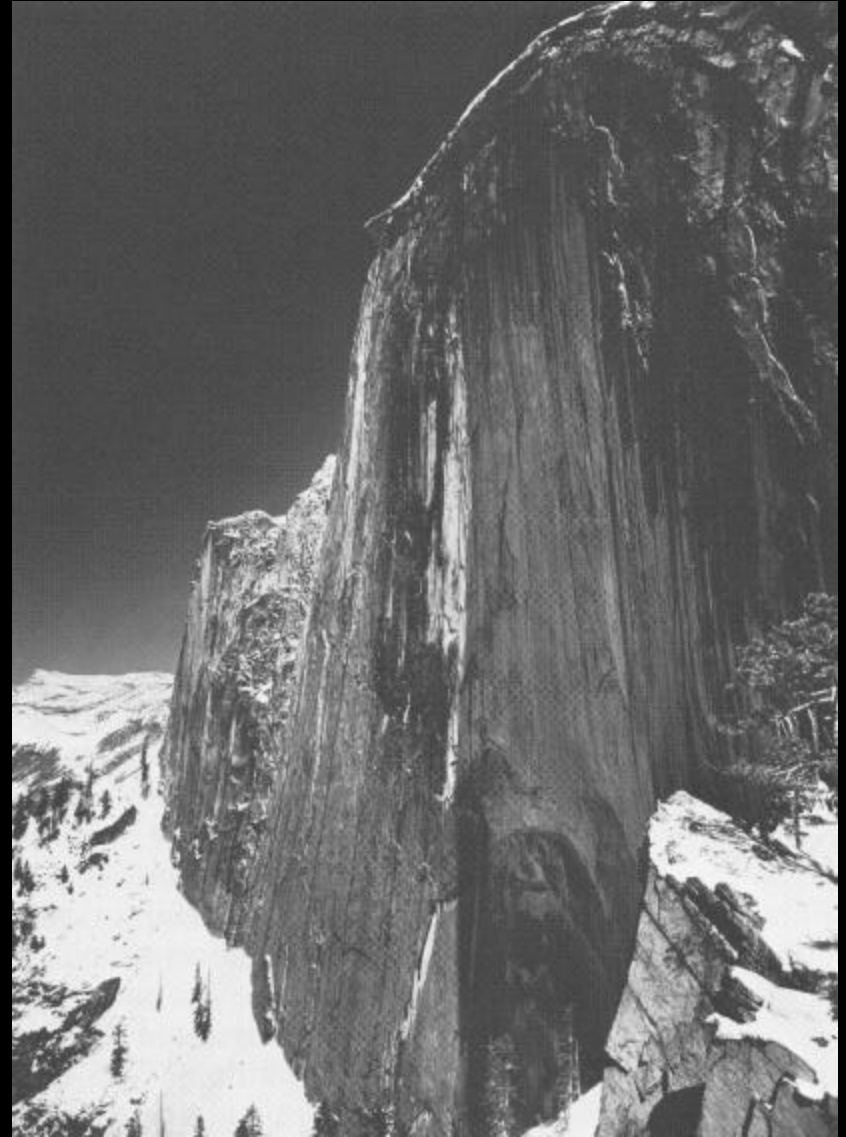
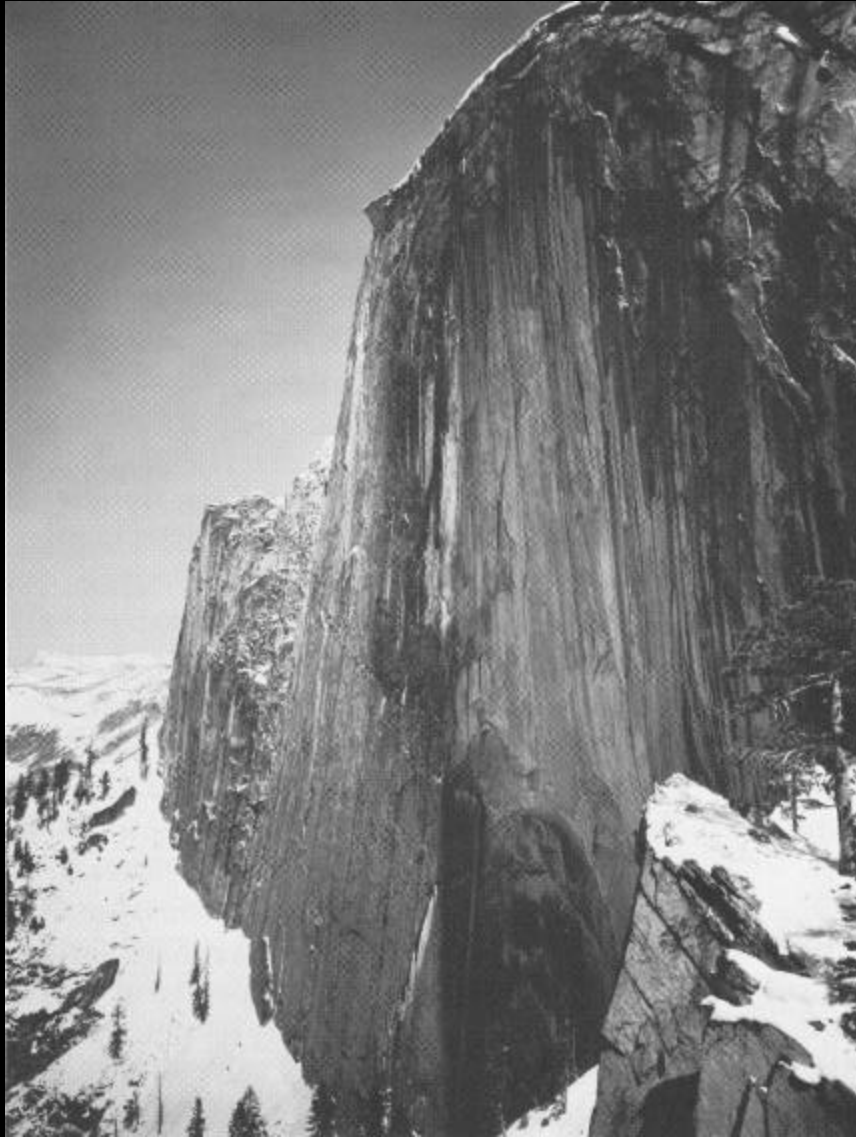
Two-solution development

- Different development of high and low value



Limitations: contrast & palette

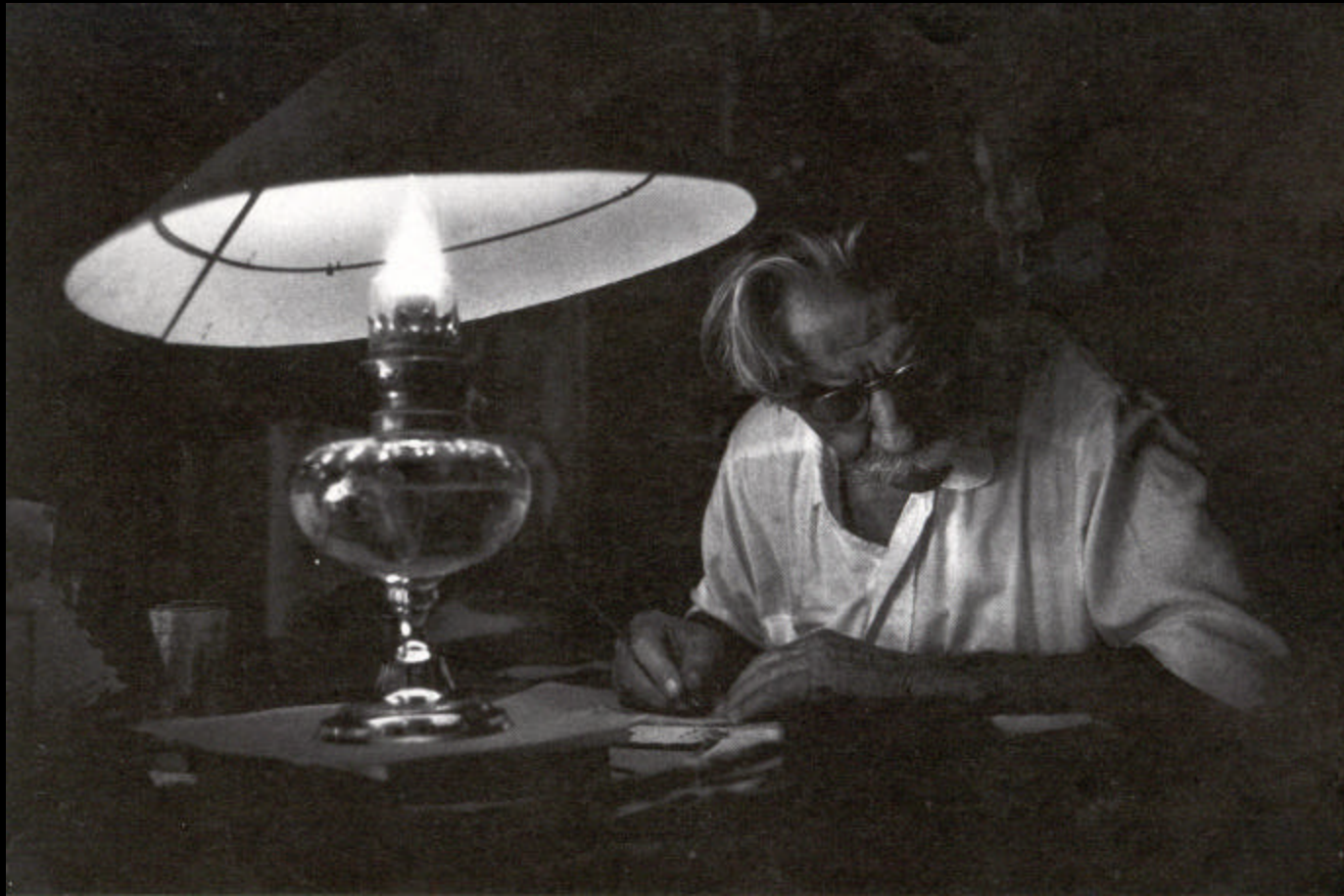
Red Filter



Limitations: contrast & palette

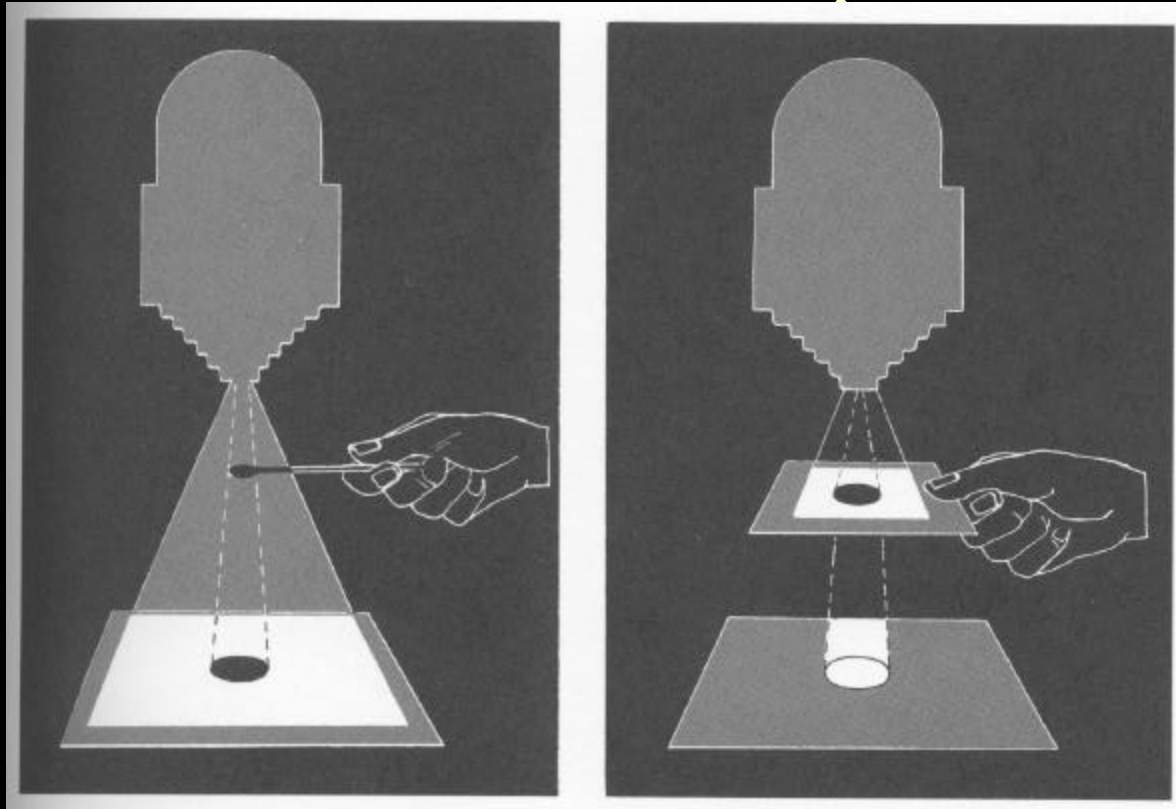
The Print

- W. Eugene Smith photo of Albert Schweitzer
- 5 days to print!



Dodging and Burning

- Locally darken or lighten
- Use masks to expose some parts less
- Has to be done for each print!



Dodging/burning



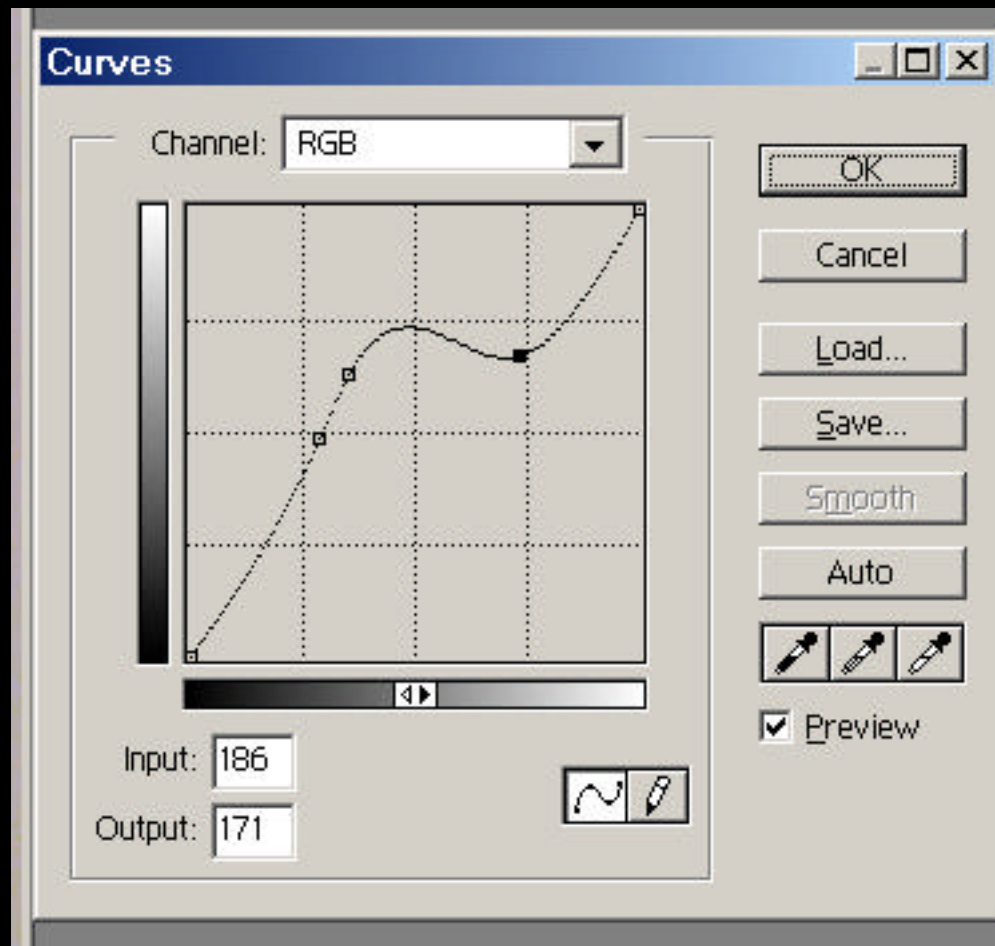
Limitations: contrast & palette

Gradient Filter

- The sky is too bright
 - Gradient filter for the top of the photo
- The house is too dark
 - Gradient filter for the bottom of the photo



Curve tool in photo editing software



Limitations: contrast & palette

The infamous 8 bits

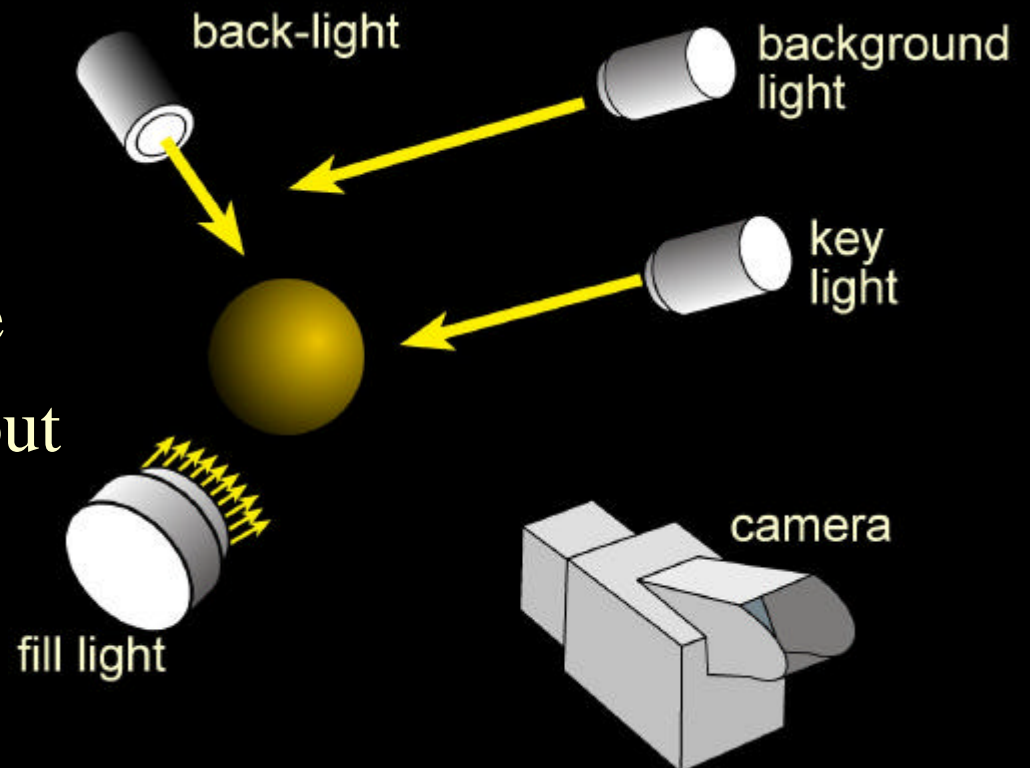
- Digital photography
- 8 bits means 1 to 255 contrast
- Enough for display
- Not enough for
 - Editing
 - Tone reproduction
 - Dodging & burning
 - Etc.

Plan

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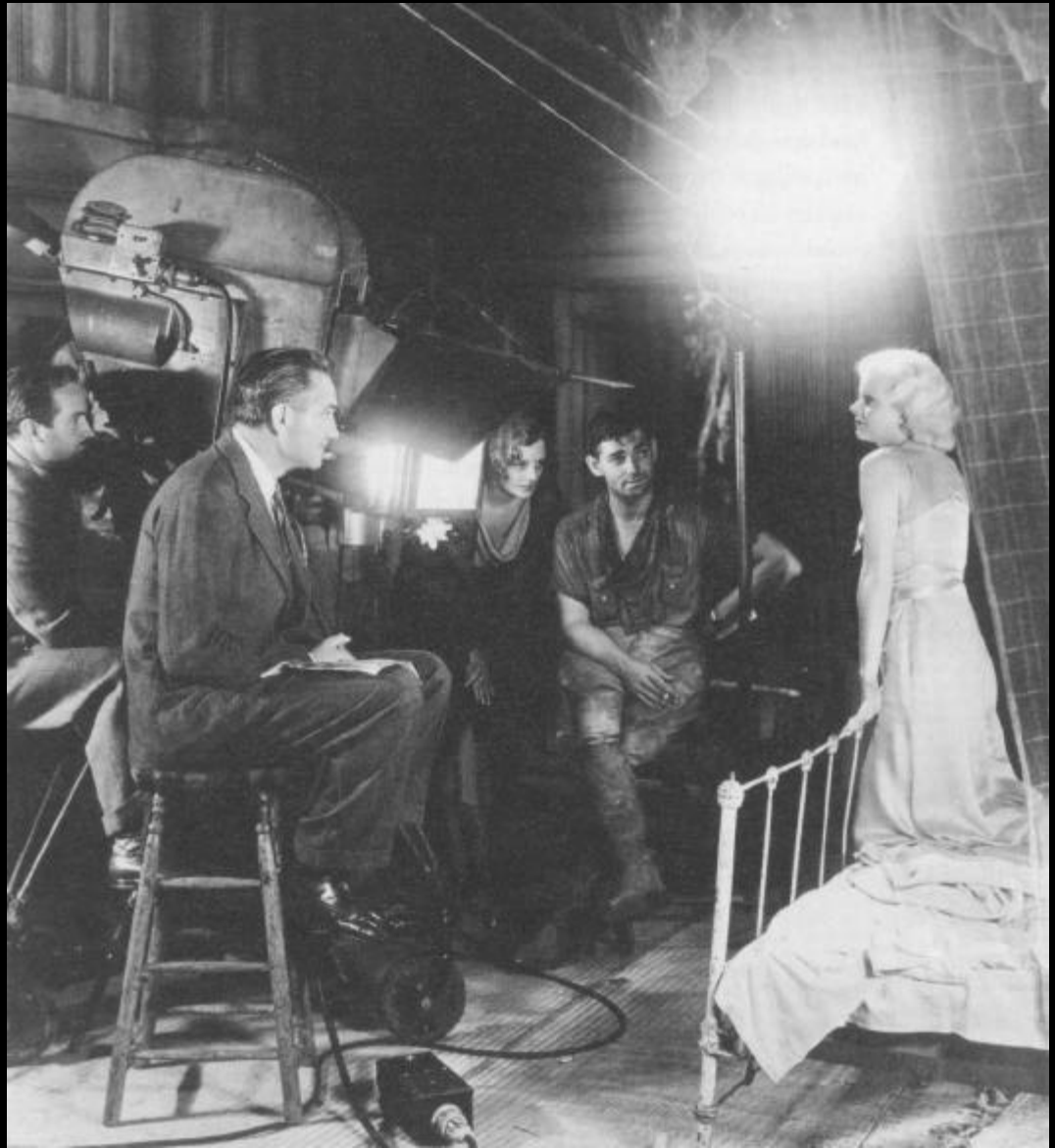
Three Point Lighting

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



Lighting

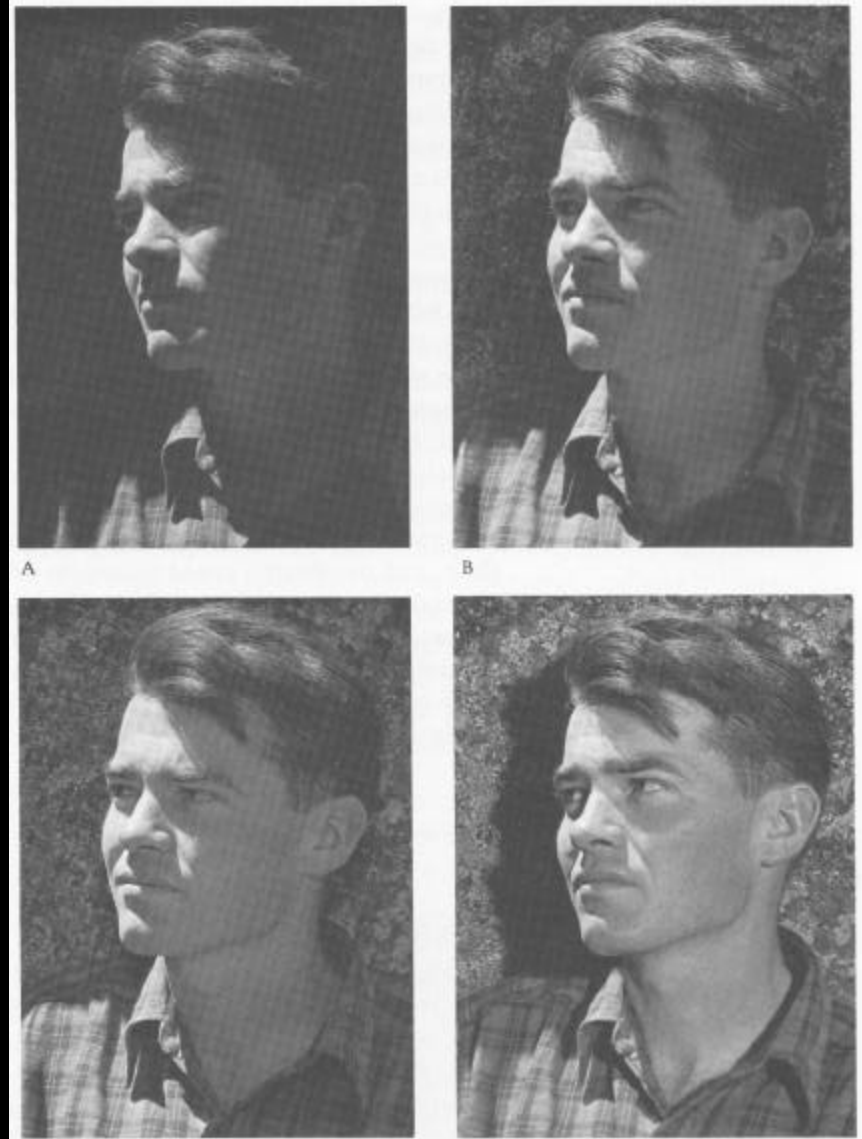
- Fill light



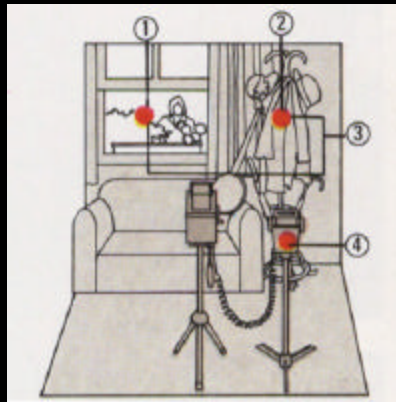
Limitations: contrast & palette

Portrait Lighting

- Ansel Adams



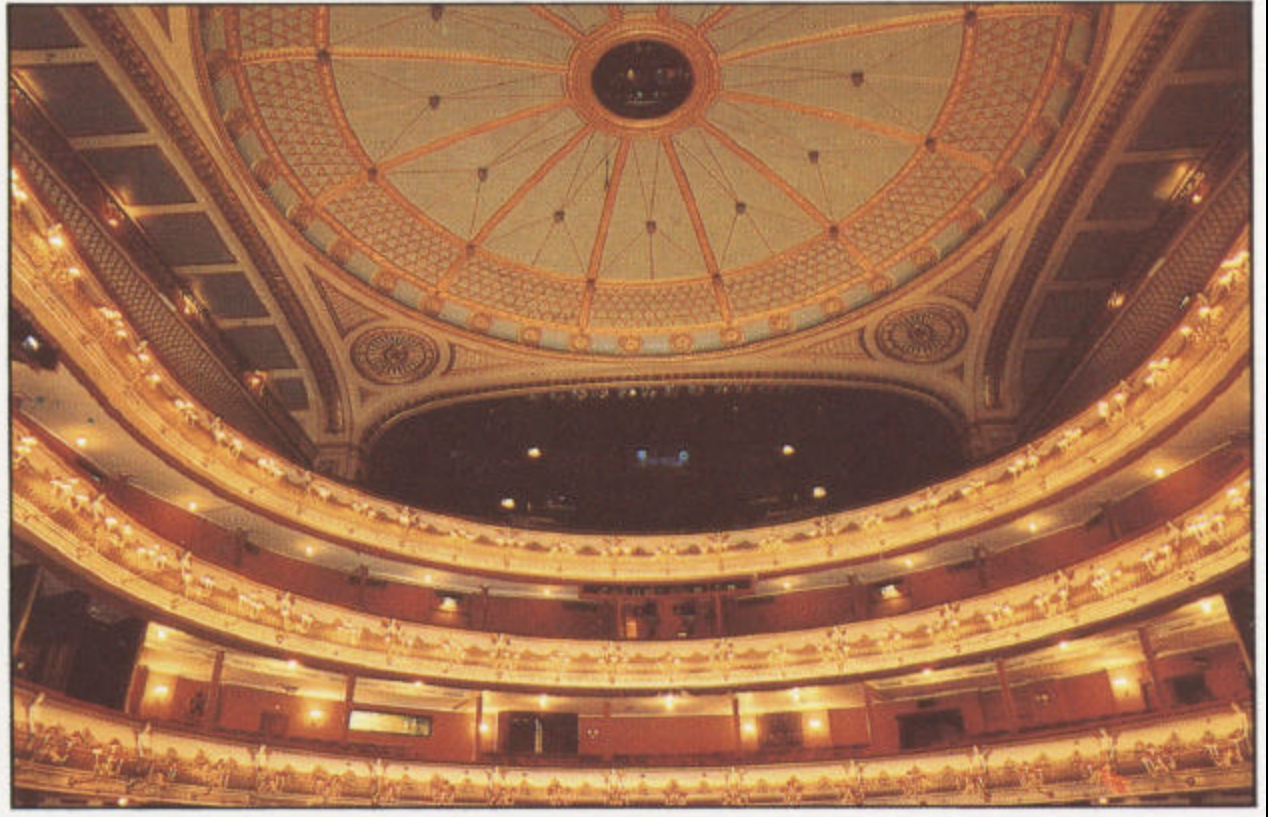
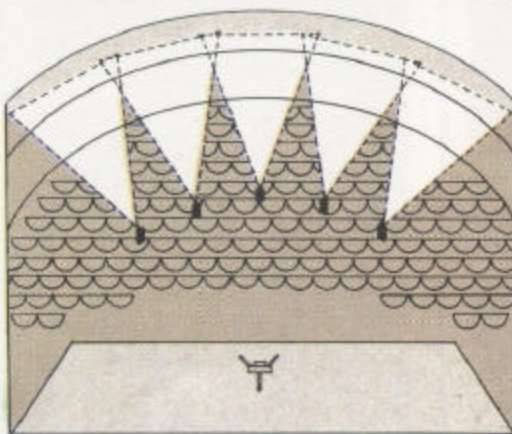
Fill-in



Limitations: contrast & palette - Shot-Perspective-Speed, aperture-Filter-**Lighting**-Processing & Print-Make up-Retouching

Lighting

- Painting with light

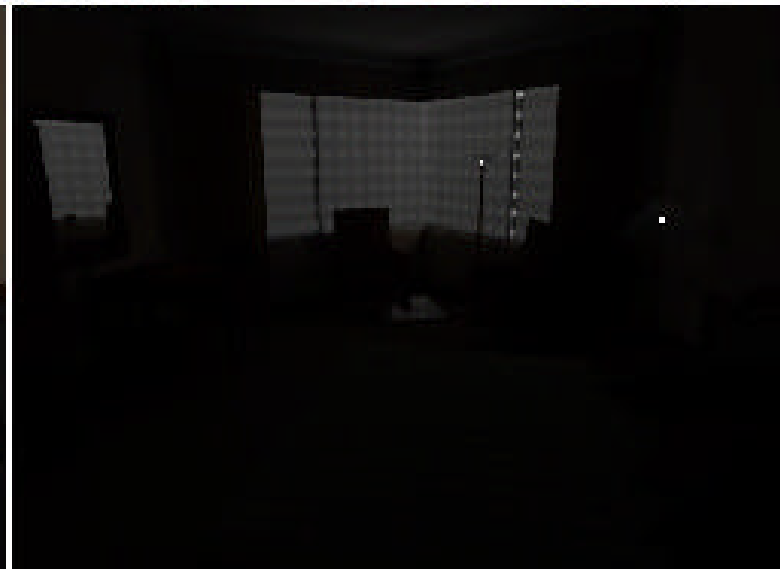
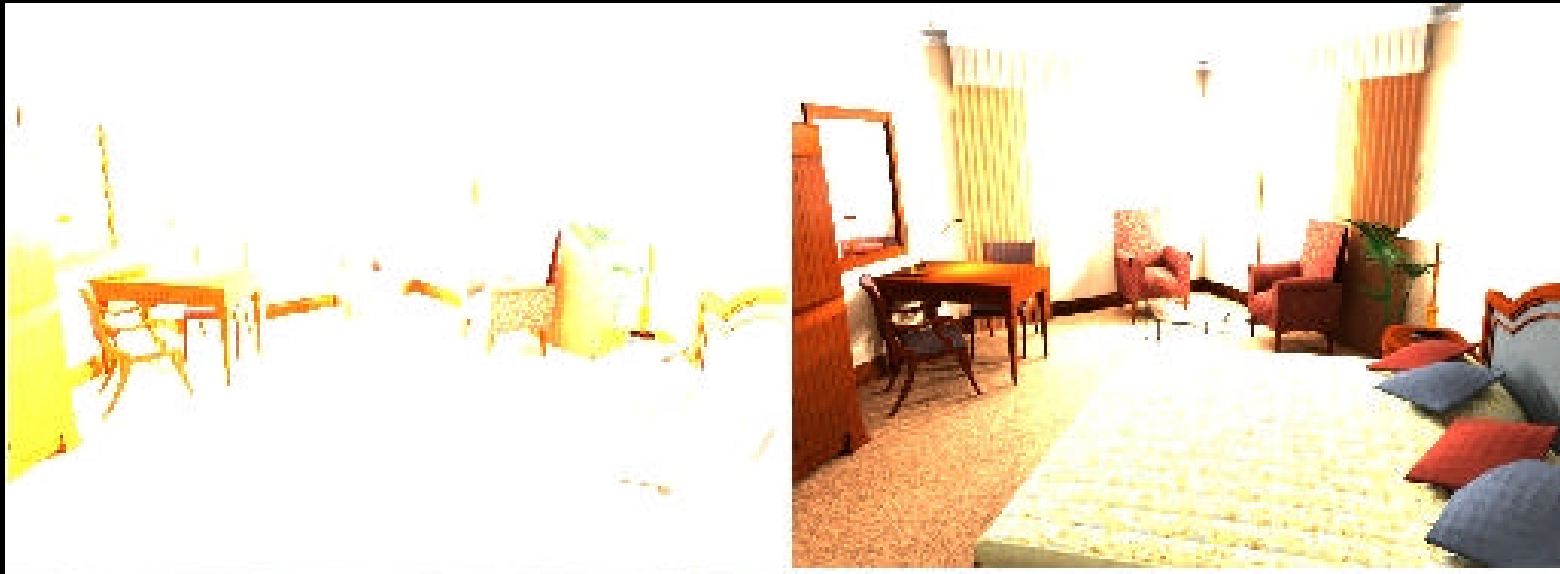


Limitations: contrast & palette

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Local contrast



Limitations: contrast & palette

Local compensation

- Use local average to compensate
- Haloing effects



Limitations: contrast & palette

Local contrast

- [Tumblin 1999]
- Organization into regions



Limitations: contrast & palette

Local contrast

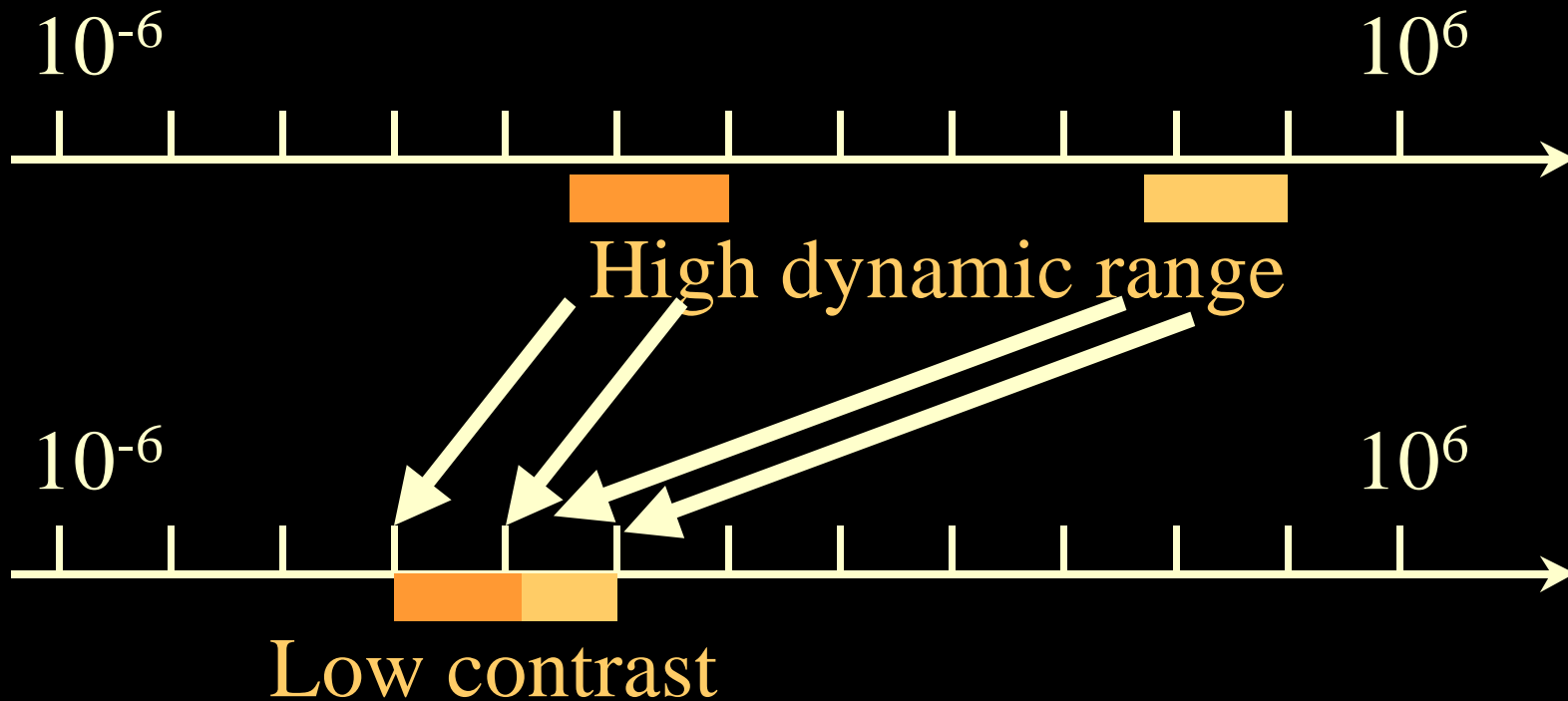
- [Tumblin 1999]
- Organization into regions



Limitations: contrast & palette

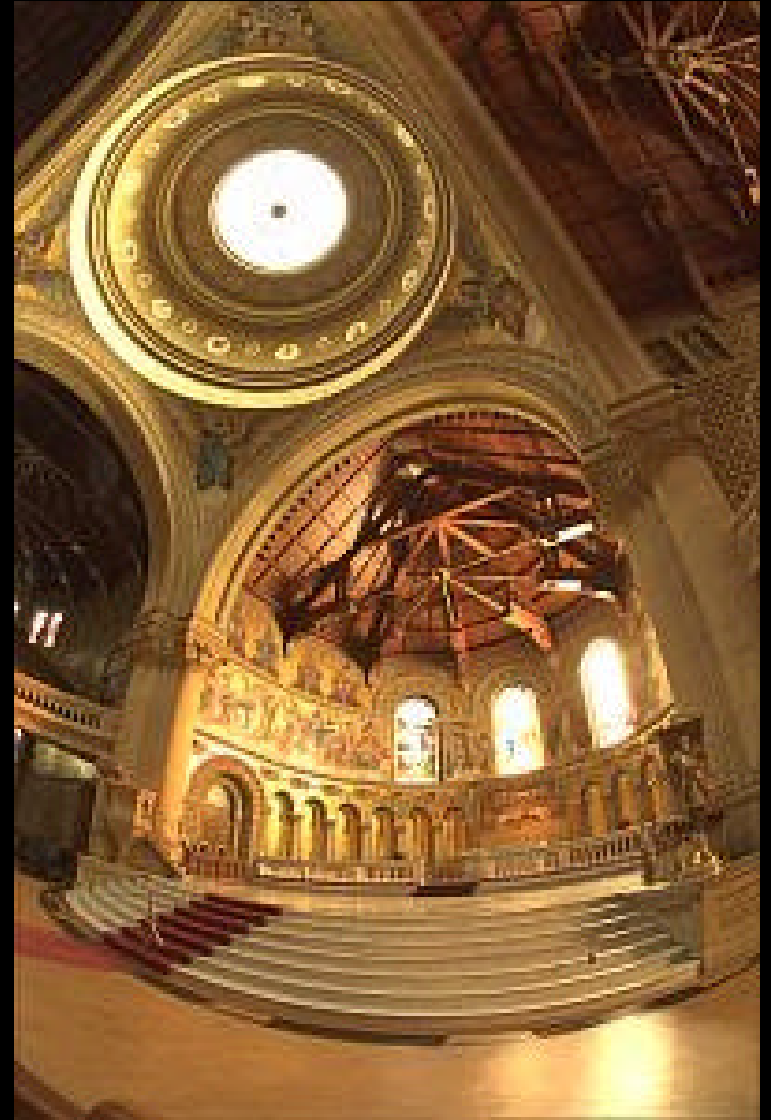
Histogram adjustment

- [Larson et al. 1997]
- Disregard empty portions of the histogram



Histogram adjustment

- [Larson et al. 1997]
- Disregard empty portions of the histogram



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Flare, halo

- Le Corbusier, *Notre Dame du Haut*, 1950-55



Limitations: contrast & palette

Flare, halo



Limitations: contrast & palette

Flare, halo

- Van Gogh, *Le Semeur*, 1880



Limitations: contrast & palette

Blue-yellow

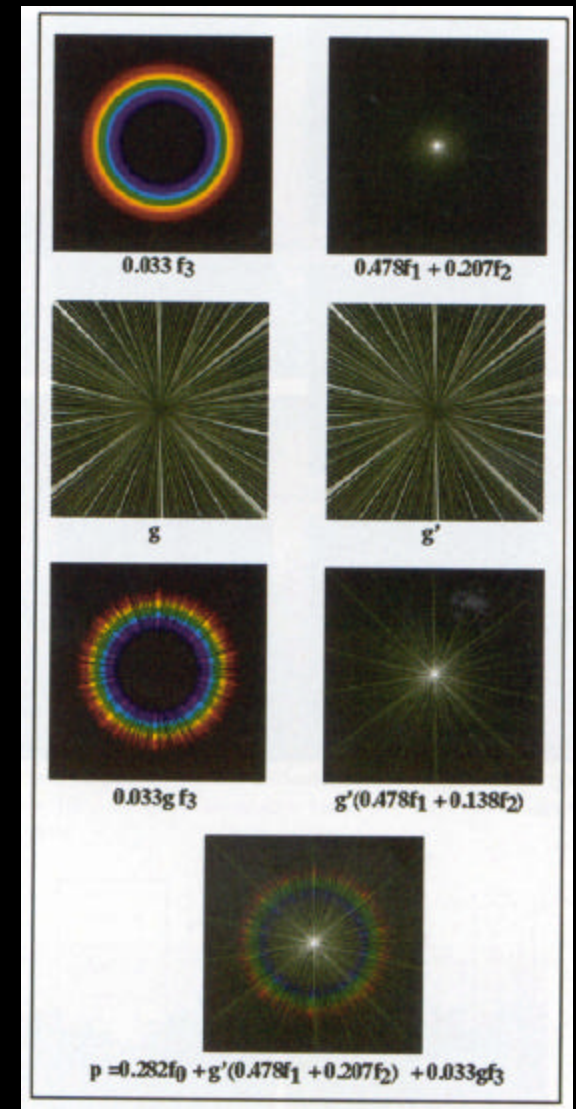
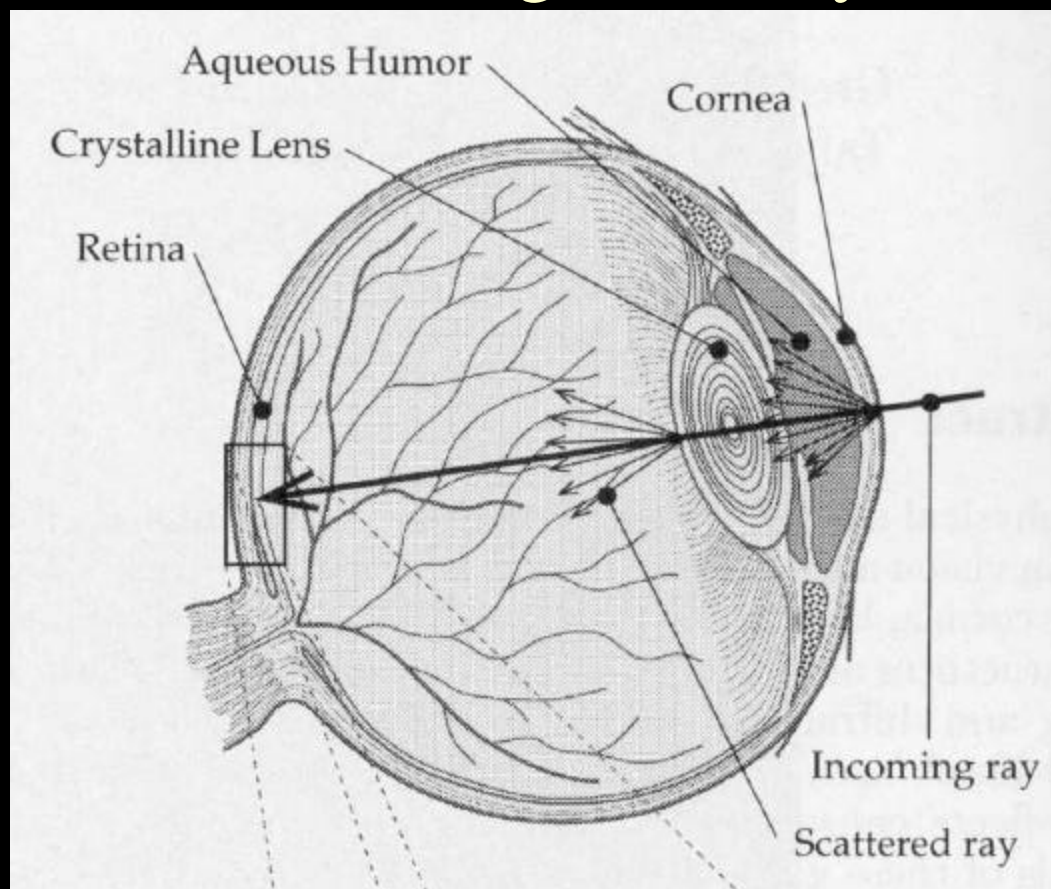
- Karl Schulpig, 1925



Limitations: contrast & palette

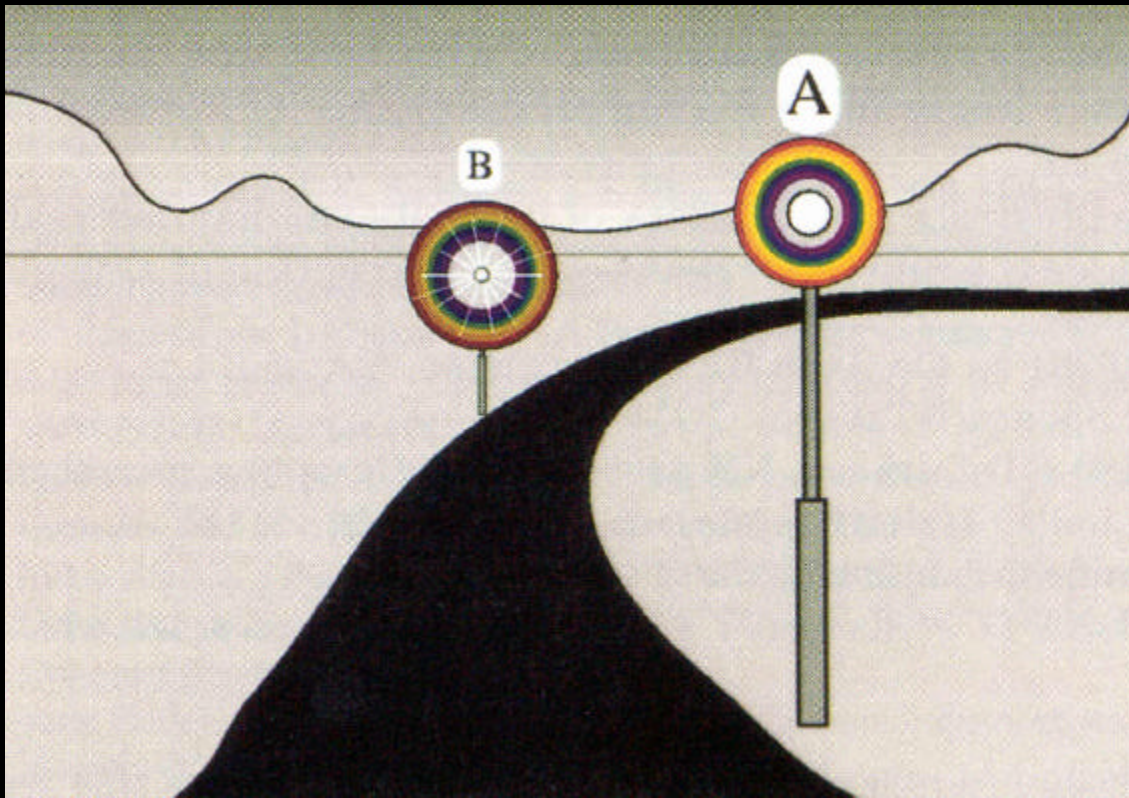
Flare in CG

- [Spencer et al 1995]
- Flare: scattering in the eye



Flare in CG

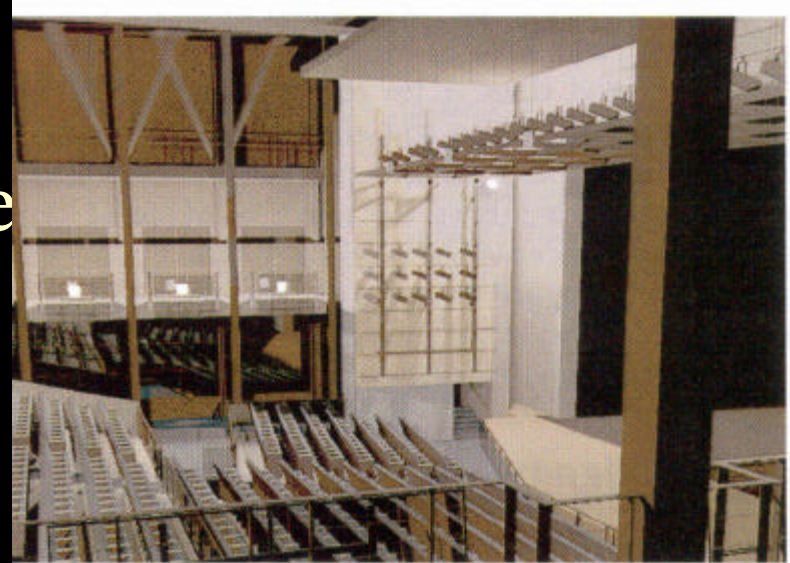
- [Spencer et al 1995]
- Flare: scattering in the eye
- Size is constant



Limitations: contrast & palette

Flare in CG

- [Spencer et al 1995]
- Flare: scattering in the eye
- Size is constant



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Local lighting

- Typically Florence Renaissance
- Mostly to reveal shape
- Raphael



Limitations: contrast & palette

Chinese painting



Limitations: contrast & palette

Tenebrism

- Early 17th
- Caravaggio



Limitations: contrast & palette

Rembrandt



Limitations: contrast & palette

Radial balance

- Georges de La Tour,
Joseph the Carpenter,
1645



Limitations: contrast & palette

White

- Filippo Lippi



Limitations: contrast & palette

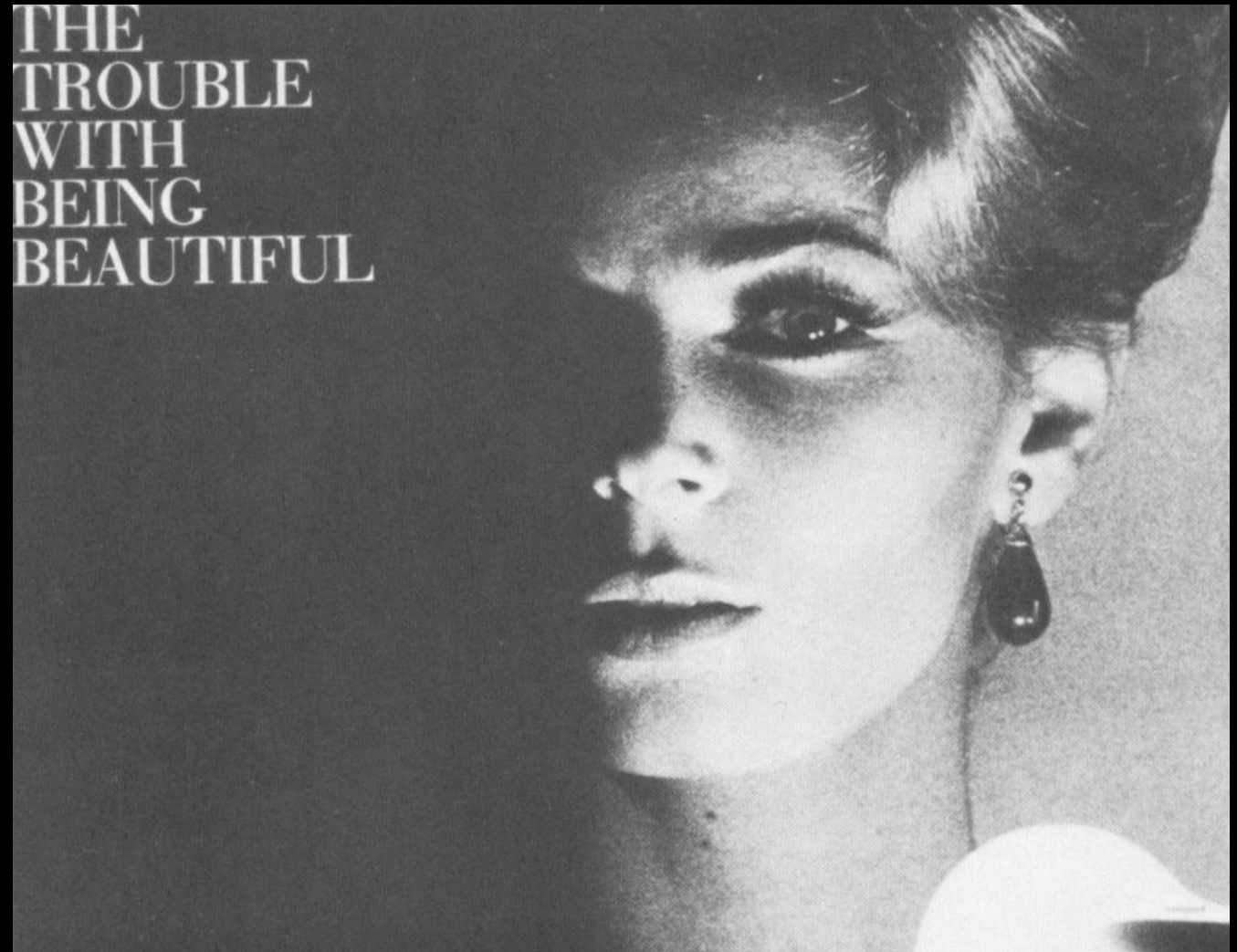
Silhouette

- Wolfrang Weber
The Lash Bird Dancer
On Madagascar
Late 20s



Contrast

- Bert Stern



Limitations: contrast & palette

Pure drawing

- Diego Riviera
Mother And Child
1936



Pure color

- Henri Matisse, *Harmony in Red*, 1908-1909



Limitations: contrast & palette

Pure color

