
Optical Information

Visual Perception

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Visual Perception

- Depends on three factors

- Light

- Interaction of light with surfaces

- Human visual system

- Observes light both before and after the interaction with surfaces

Optical
Information

Light

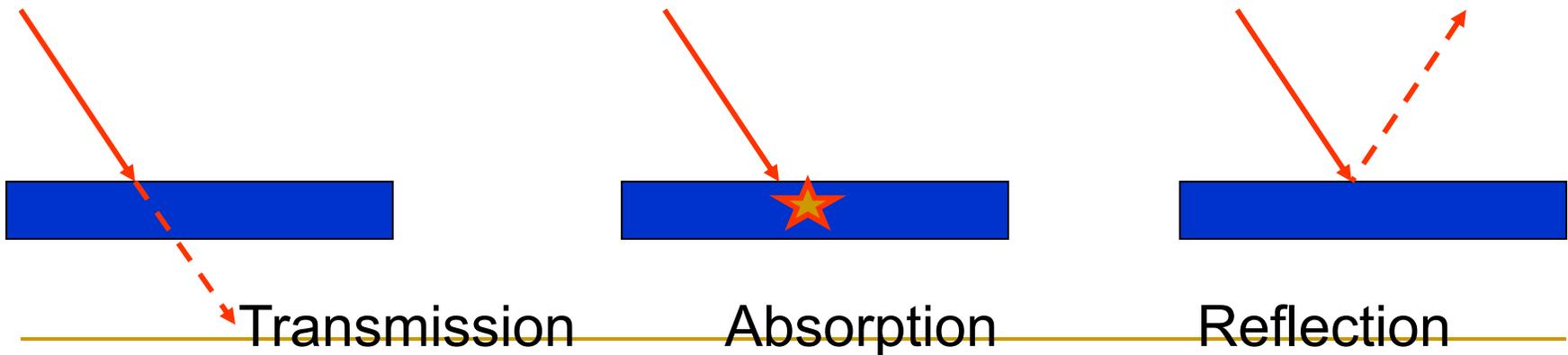
- Made of small packets
 - Photons
 - Travel at 186,000 mph
 - Travels in straight line
 - Behaves like particles
 - Behave like waves
 - Important for color vision

Light source

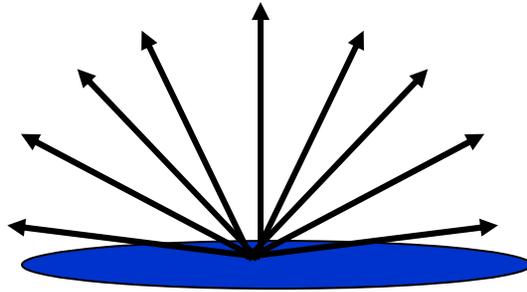
- Anything that emits light
- Point light source
 - Sharp shadows and shading effects
 - Unrealistic
- Extended light source
 - Blurred shadows and shading effects
 - Diffused illumination
 - Most real sources are extended

Illumination

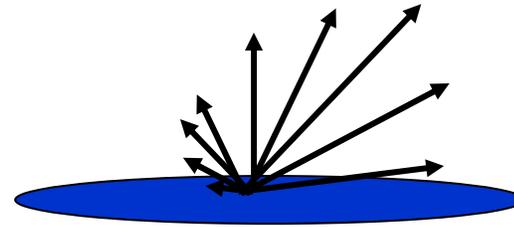
- Light strikes another surface
 - Reflected – Most of the time we see this
 - Transmitted
 - Absorbed



Diffused and Specular Surfaces

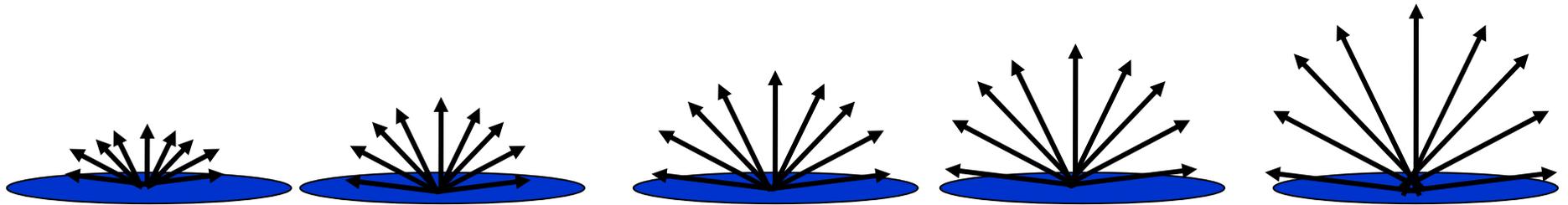
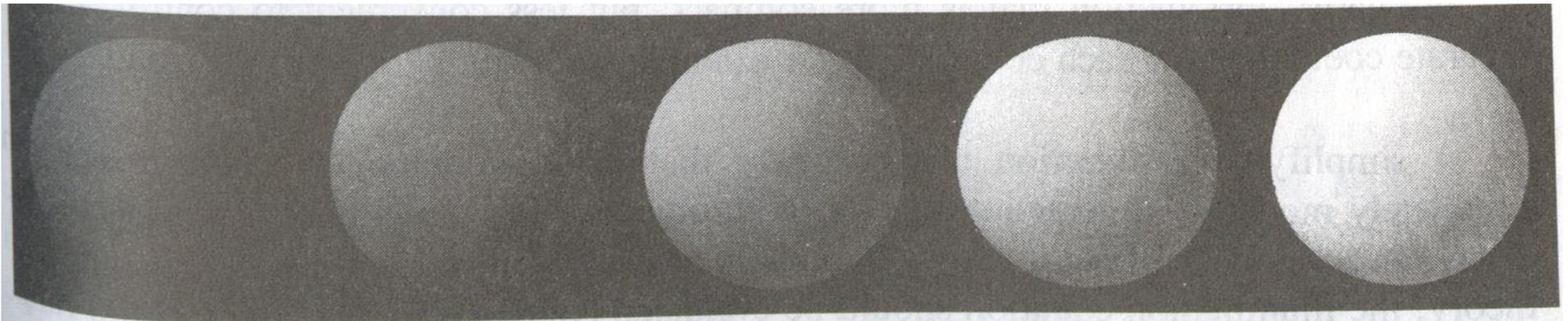


Diffused



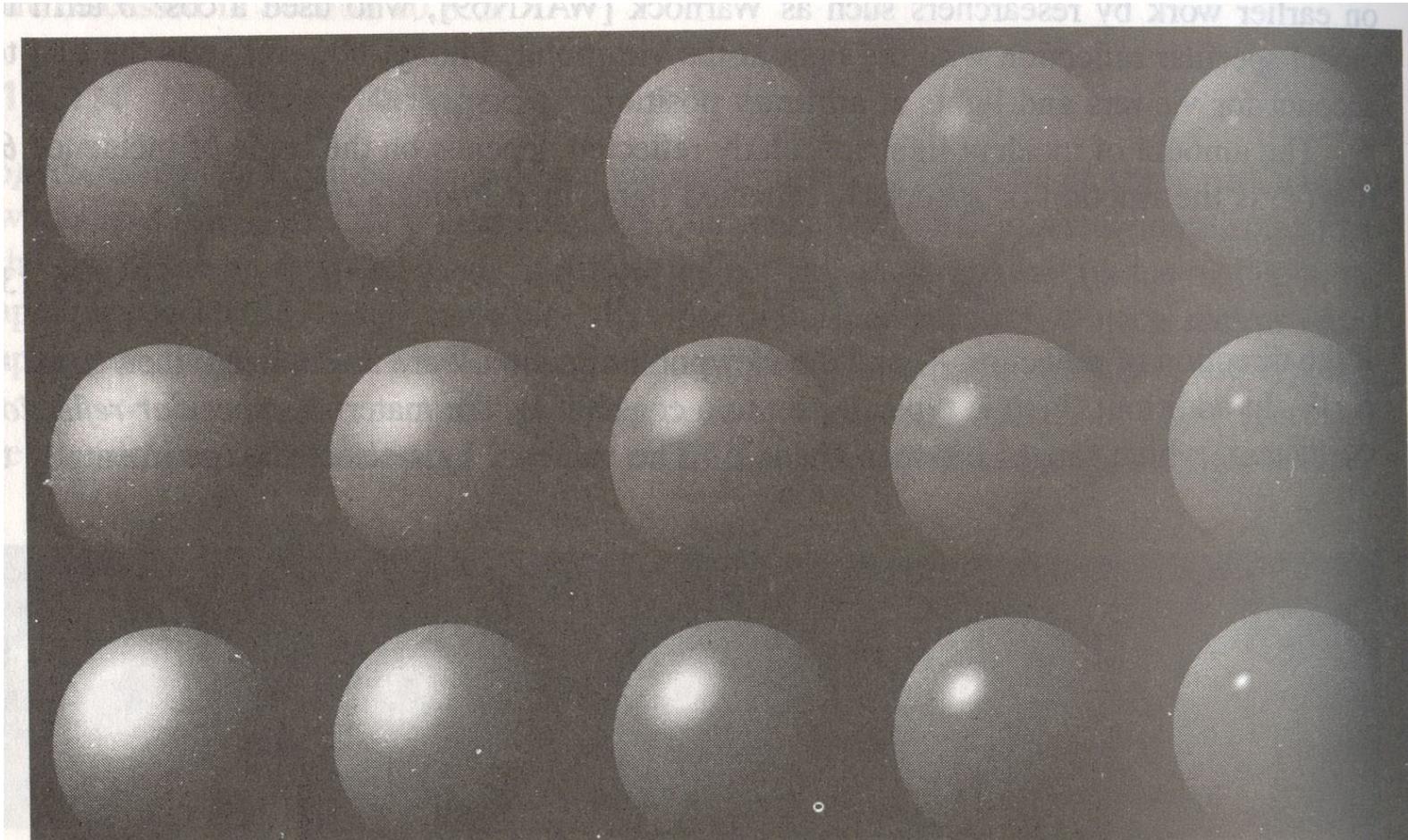
Specular

Diffused Surfaces (View Independent)



Specular Surfaces (View Dependent)

Relative amount of light reflected



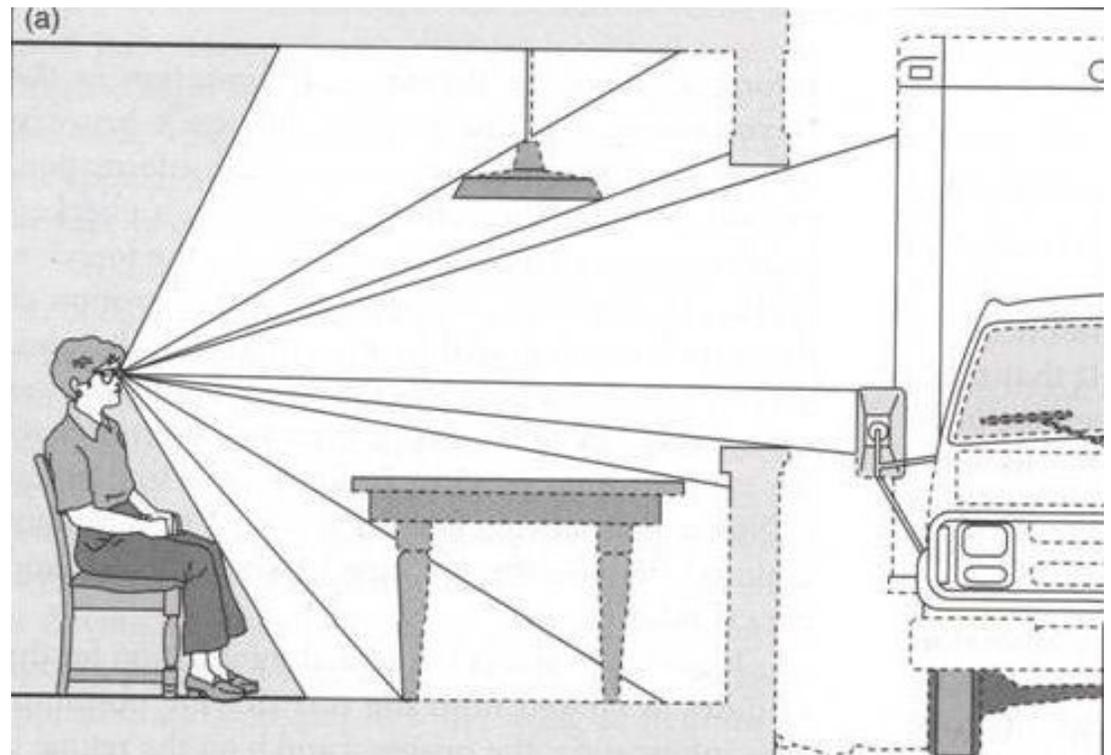
Shape of the reflectance

Illumination

- Light source
- Reflected off the surface
- Reflection again
 - Secondary source
- Again and again and again ...
- Different amount of light coming from different directions help us distinguish objects
- Equal amount of light from all directions
 - *Gray Ganzfeld*

Ambient Optic Array

- Proposed by famous psychologist J. J. Gibson
- Light coming towards a given observer from all directions



Ambient Optic Array

- Changes with changing view point – Optic flow
- Used to detect motion, depth and size

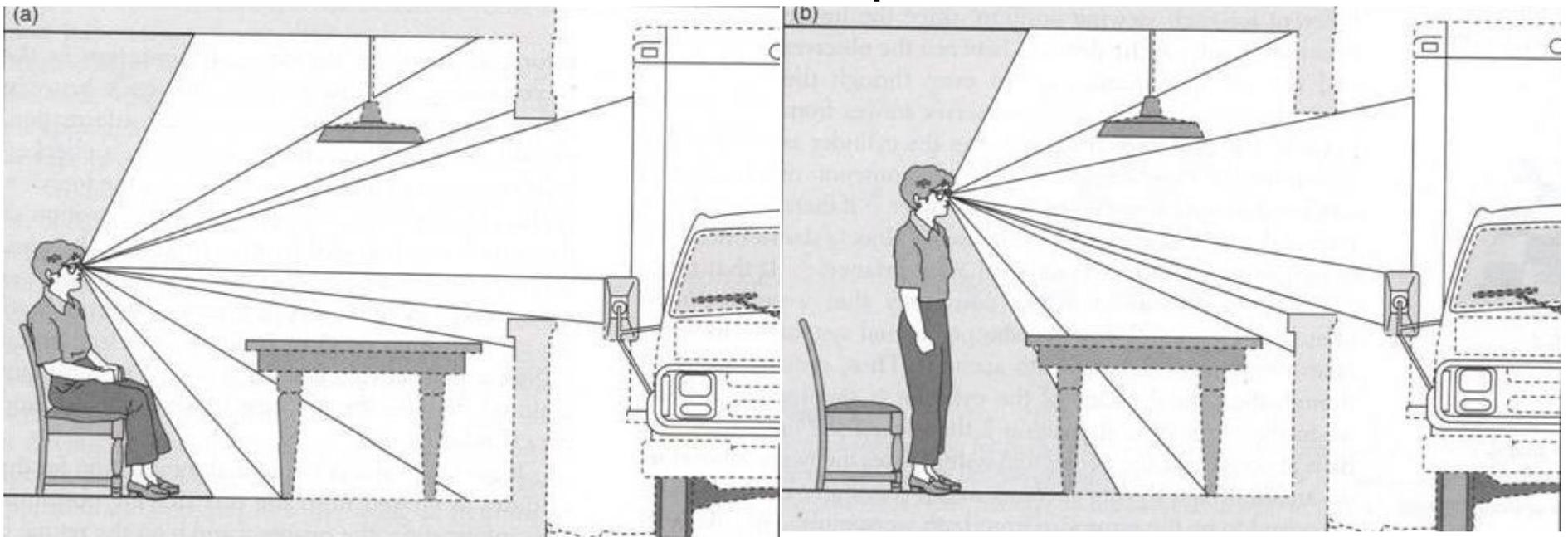
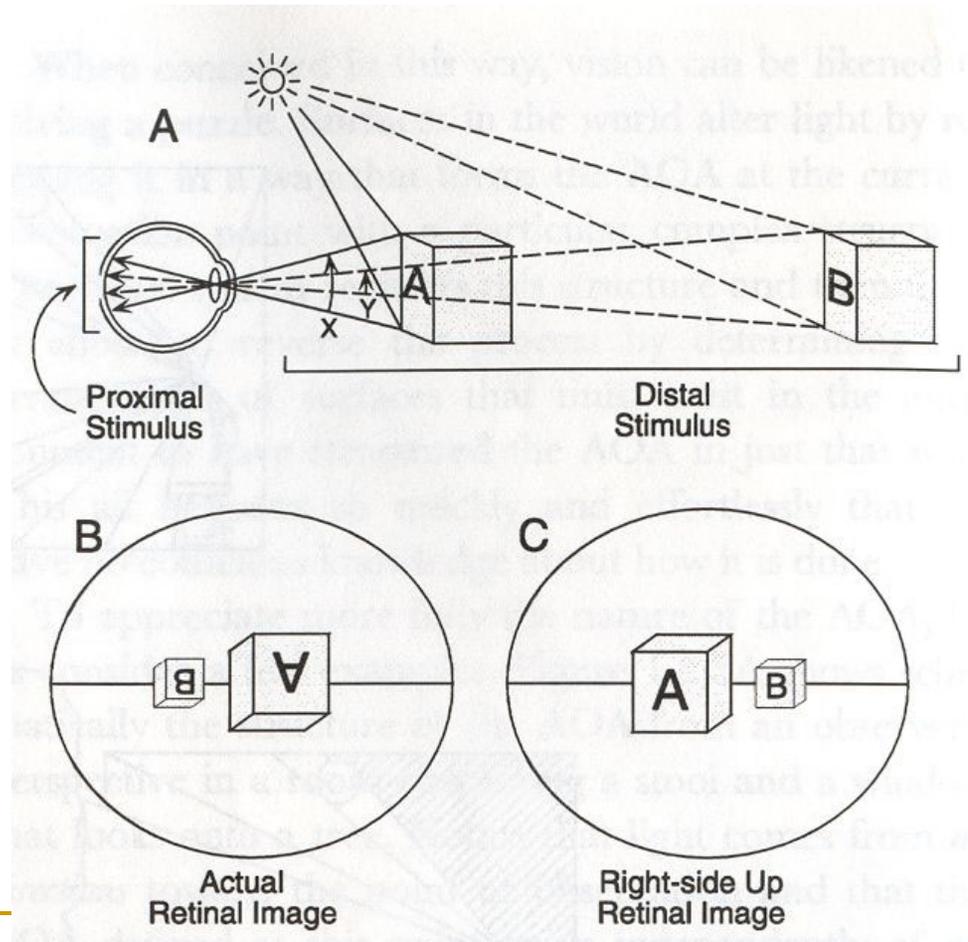


Image Formation

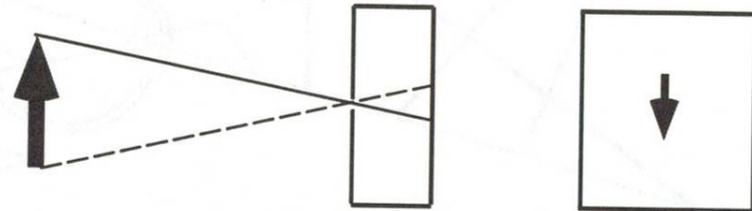
- Distal and proximal stimulus
- Size depends on the visual angle
- Depth is lost
- Occlusion
 - Light from non-occluded surfaces reach the eye



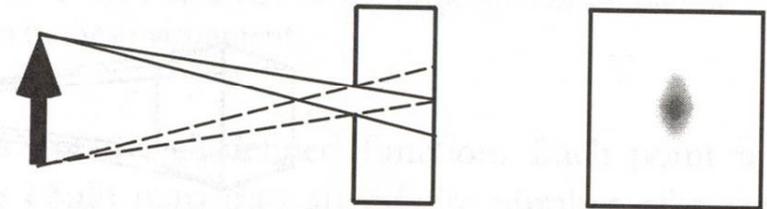
Projective Geometry

- Mathematics that guide 2D image formation of 3D world
 - Pin-hole camera model
 - Perspective Projection
 - Use of lens

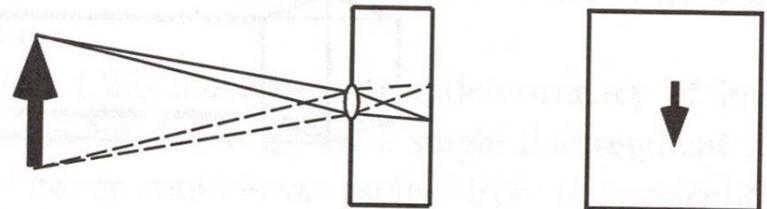
Environmental Object (Distal Stimulus) Camera Projected Image (Proximal Stimulus)



A. Pinhole Aperture without Lens --> Sharp Image

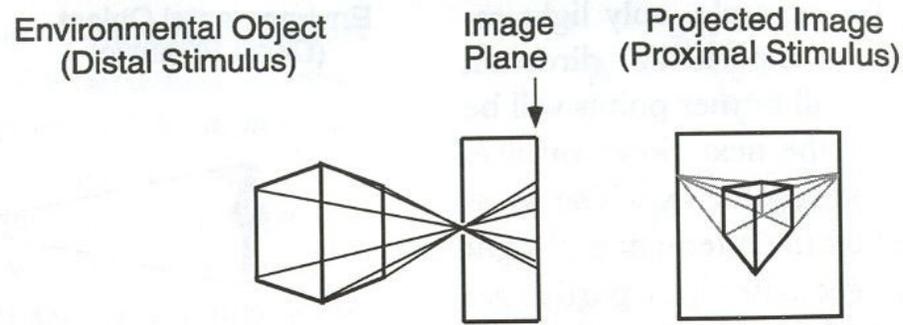


B. Large Aperture without Lens --> Fuzzy Image



C. Large Aperture with Lens --> Sharp Image

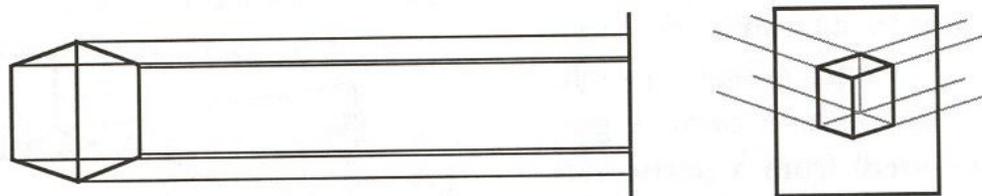
Perspective and Orthographic Projection



A. Perspective Projection (Close)



B. Perspective Projection (Far)



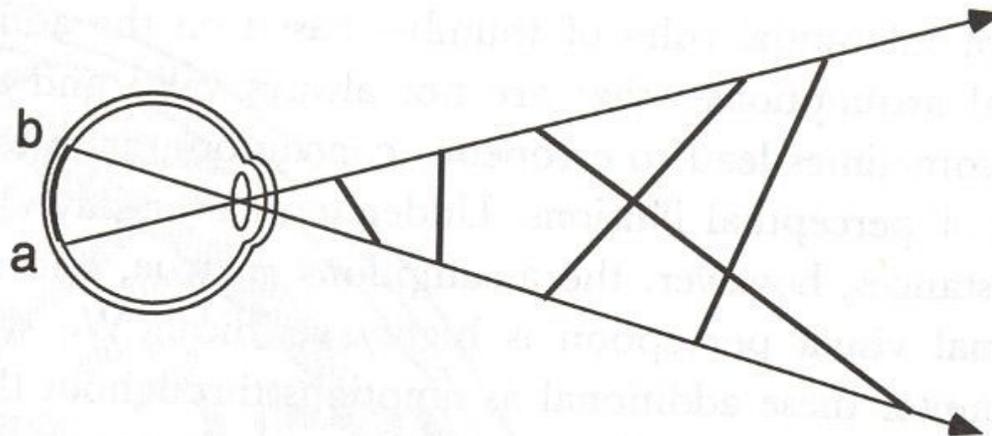
C. Orthographic Projection

Graphics Problem

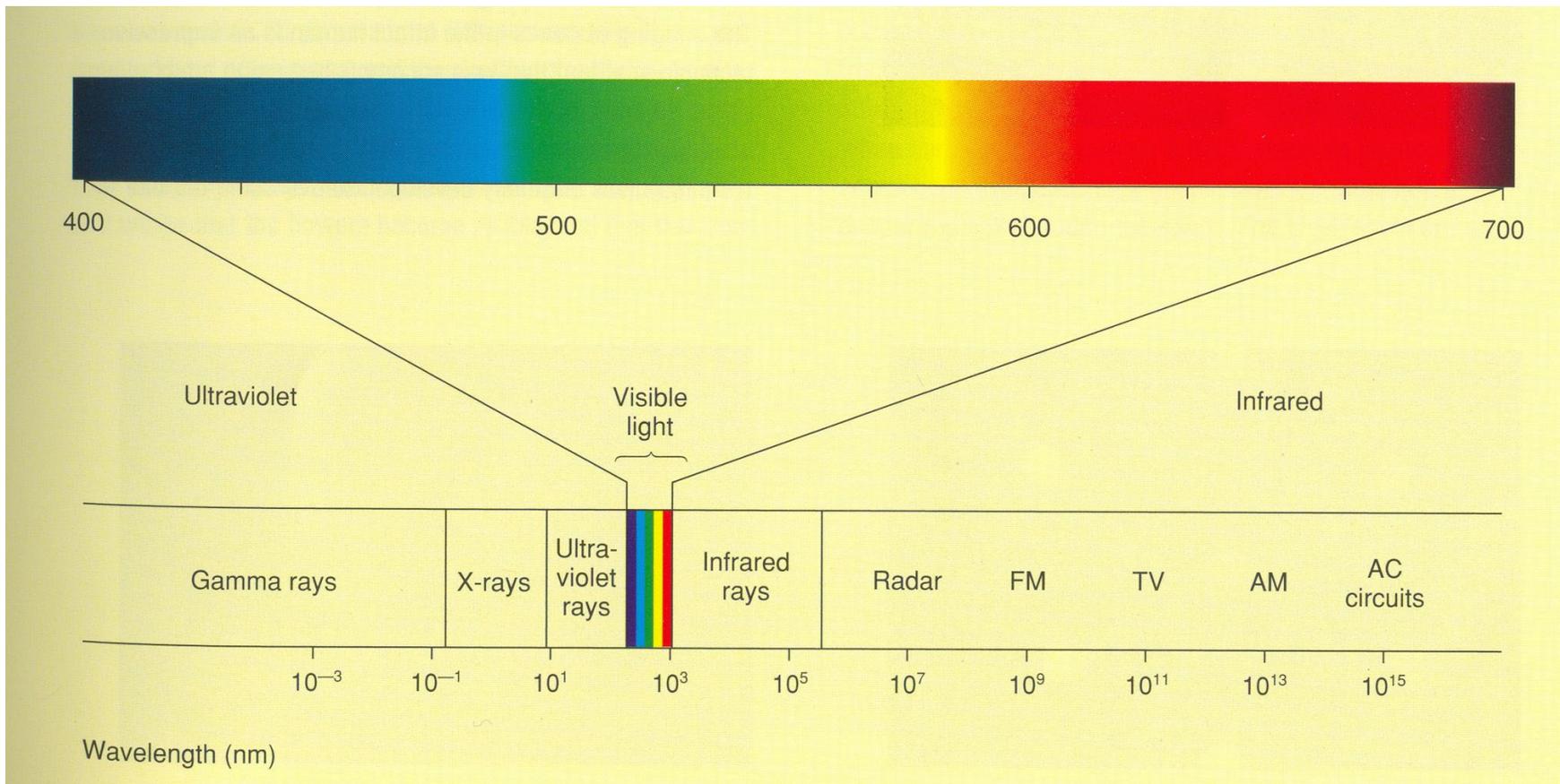
- Graphics deals with
 - How 2D images are created from 3D information?
- Rendering
 - 3D Model of the Scene
 - Locations of lights, Surface reflectance properties
 - Color at every 3D point can be calculated
 - Geometric Model, Viewpoint
 - Projection of the objects from the eye
 - Use the colors to create the 2D image

Inverse Vision Problem

- Vision deals with
 - How to get back 3D information from 2D images?
 - Underdetermined problem
 - How does the visual system solve this problem?



Photons with wavelengths



Spectrum

