CVi – 1
Introduction to Computer Vision

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IEETA / Universidade de Aveiro

Outline

- Computer Vision?
- History of Cameras
- Pinhole Model
- The Human Visual System

Acknowledgements: Most of this course is based on the excellent courses offered by Prof. Shree Nayar at Columbia University, USA and by Prof. Srinivasa Narasimhan at CMU, USA and these slides have been mostly prepared by Prof. João Paulo Cunha . This was also based on Prof. Miguel Coimbra's slides. Please acknowledge the original source when reusing these slides for academic purposes.

Topic: Computer Vision?

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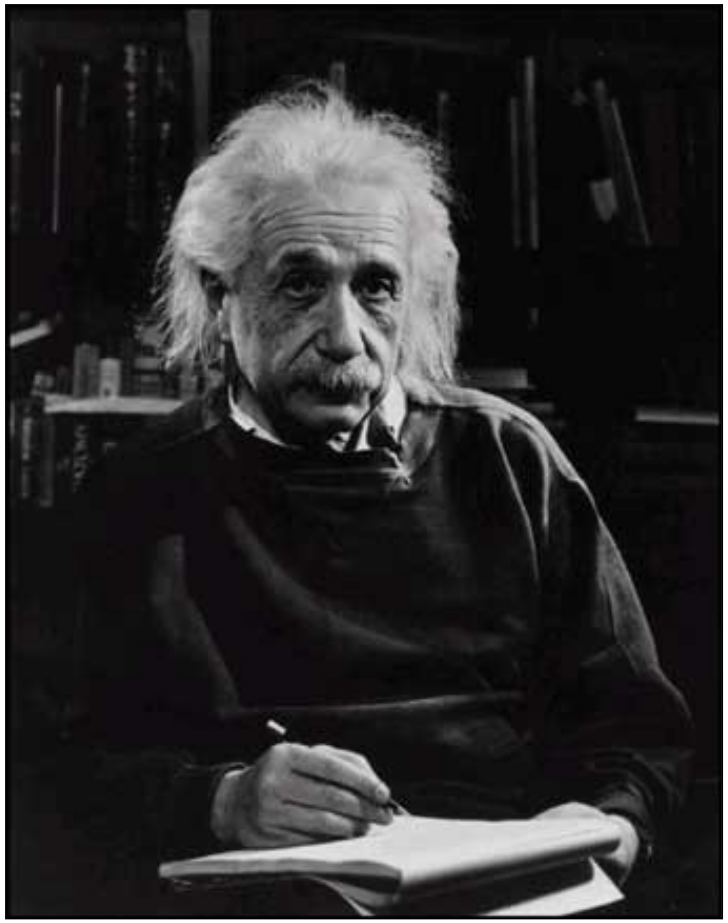

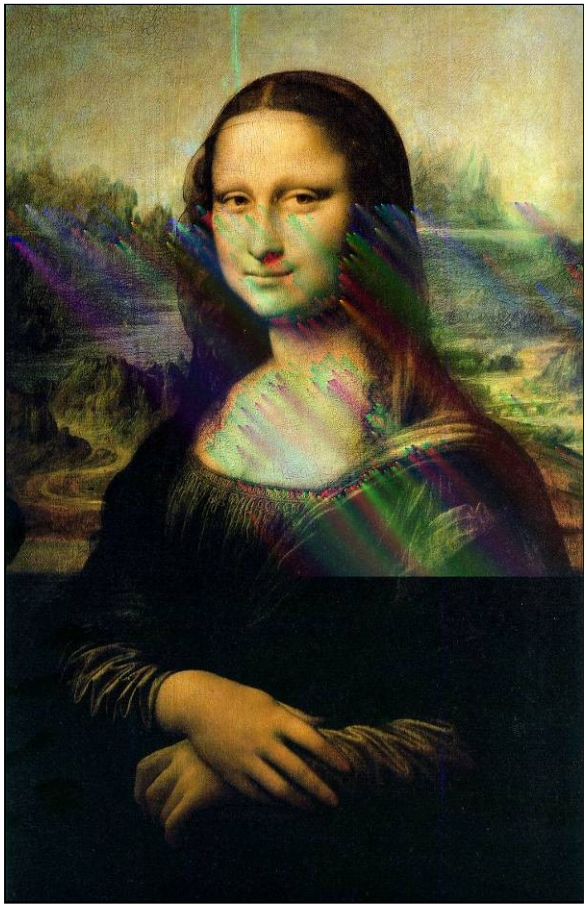

Human Vision

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  - Understand mood in the scene
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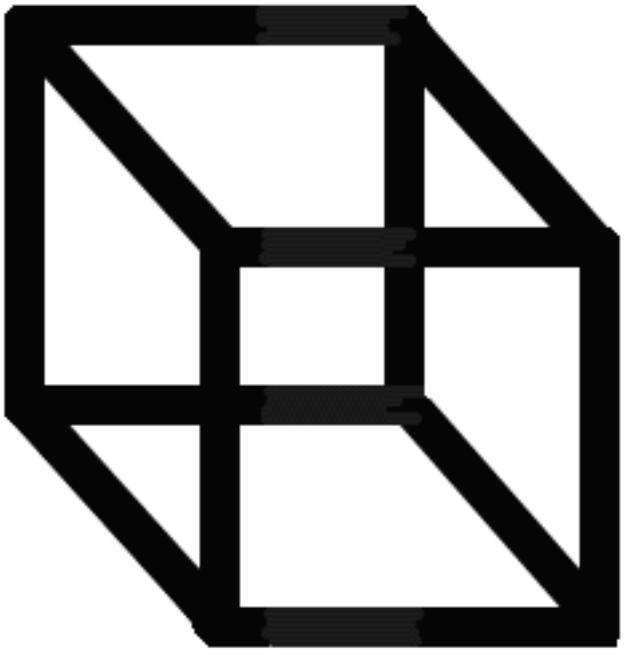

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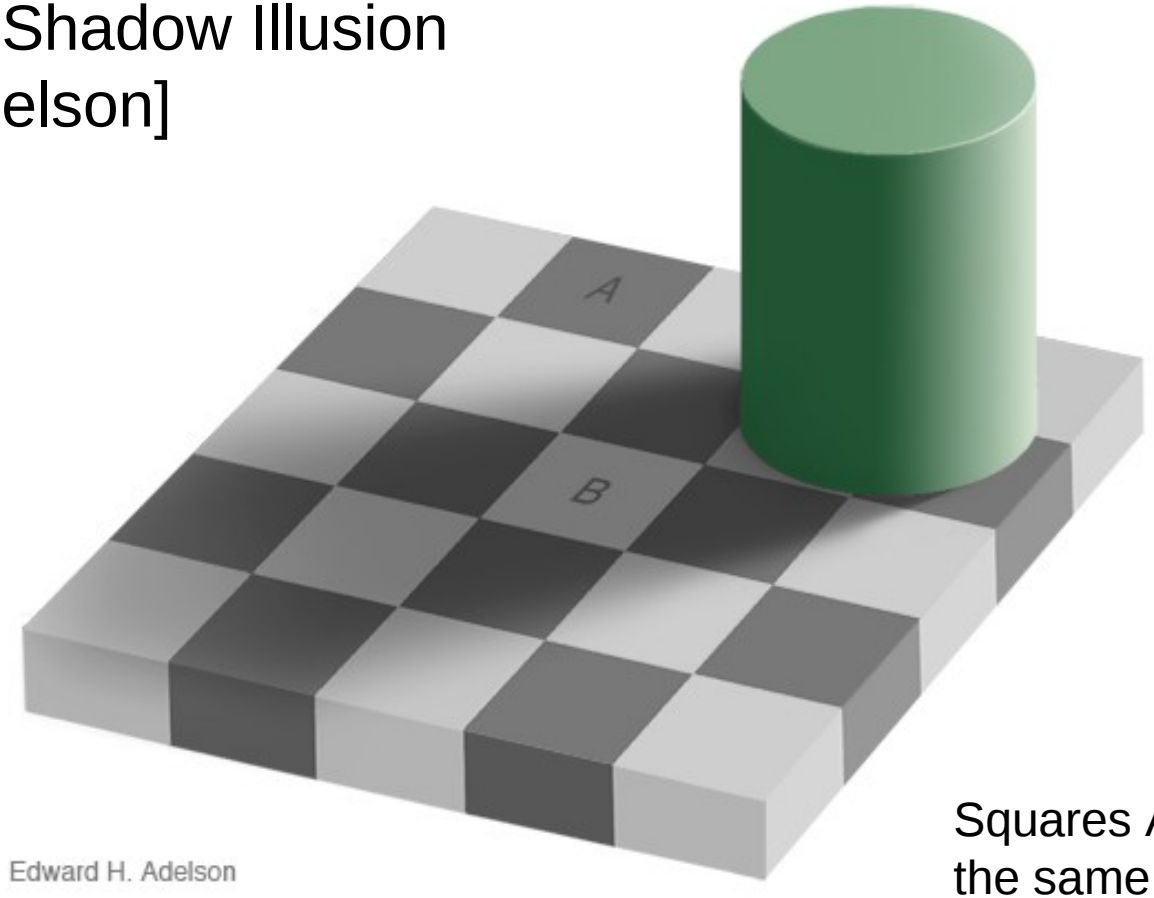

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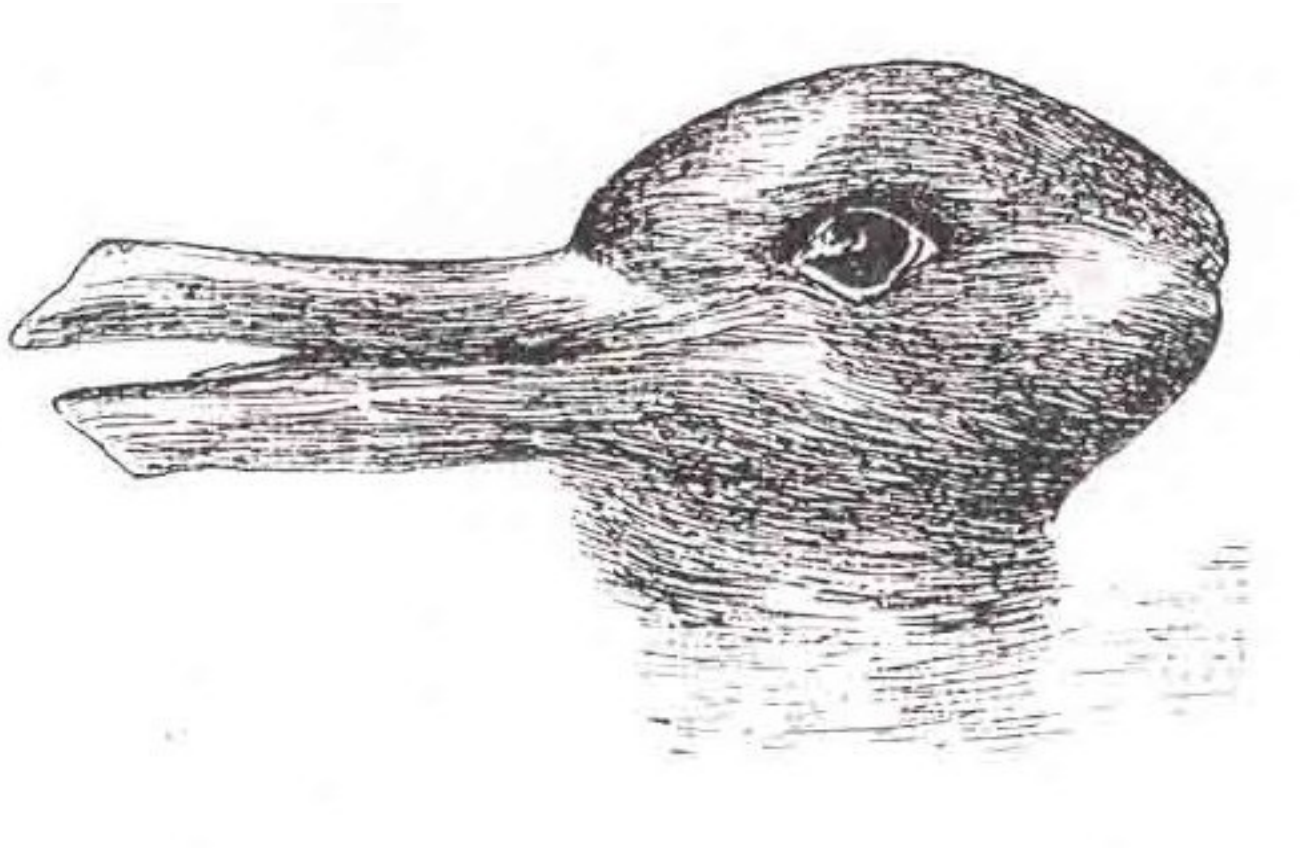

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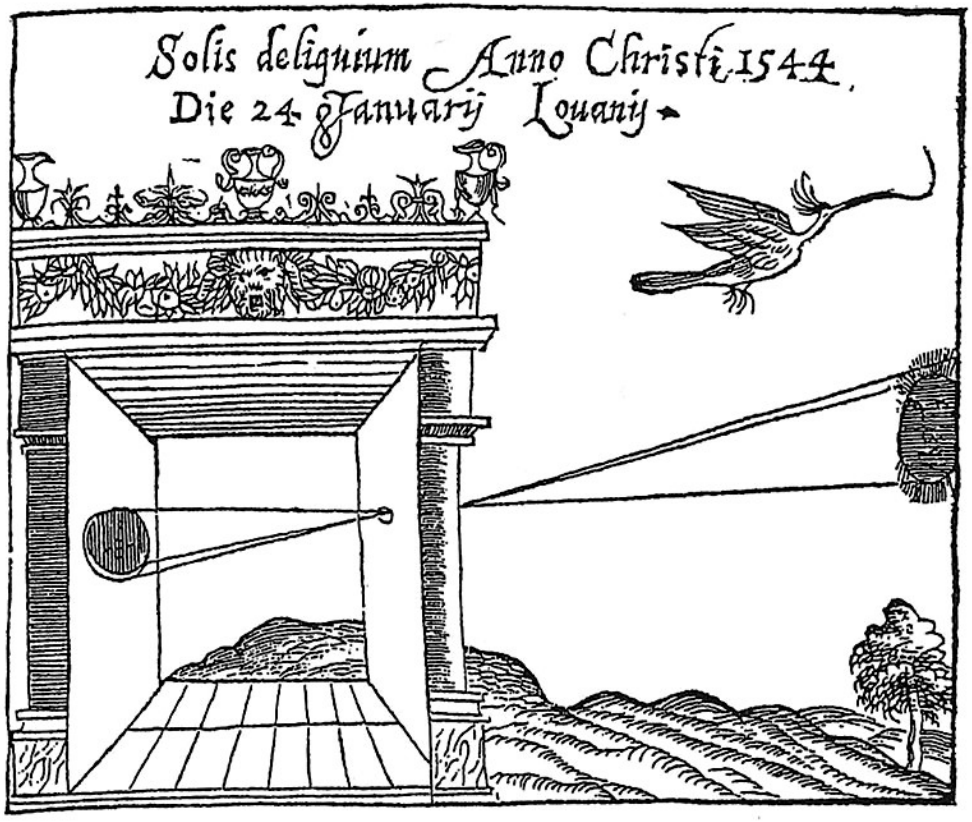
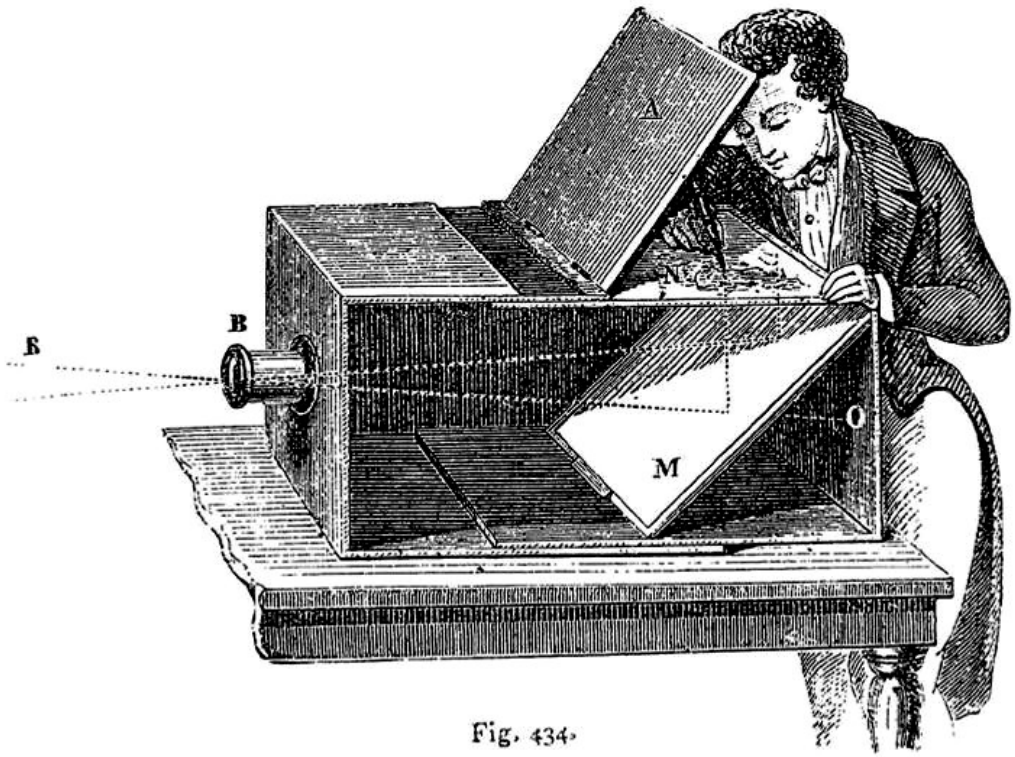
A Brief History Cameras



Camera Obscura, Gemma Frisius, 1544

1544

A Brief History of Cameras



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A Brief History of Cameras

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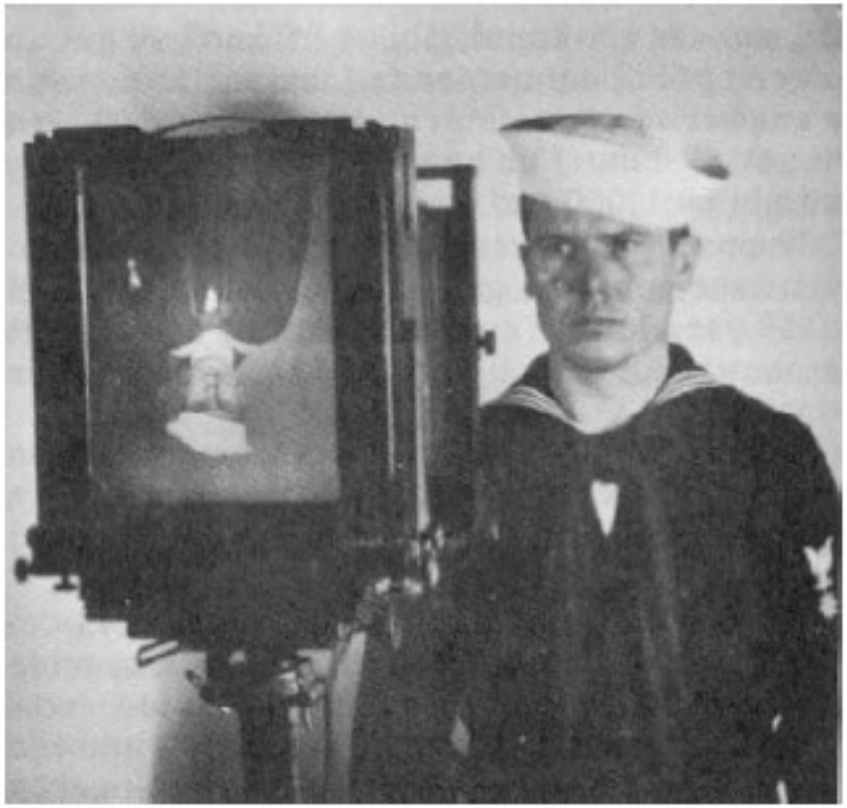

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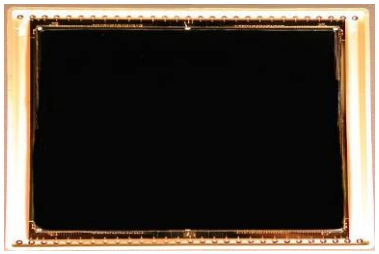

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A Brief History of Cameras

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Topic: Pinhole Model

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Pinhole Camera Model

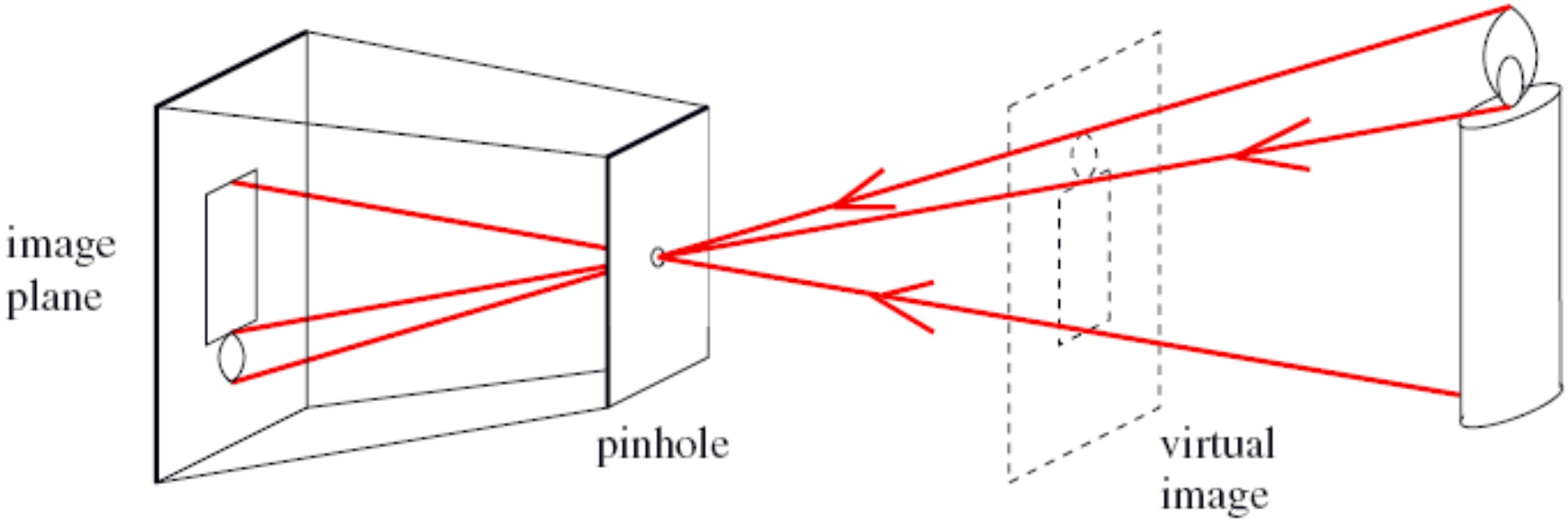

Figure 1.2. The pinhole imaging model.

Pinhole or central perspective, Bruneleschi, XV century

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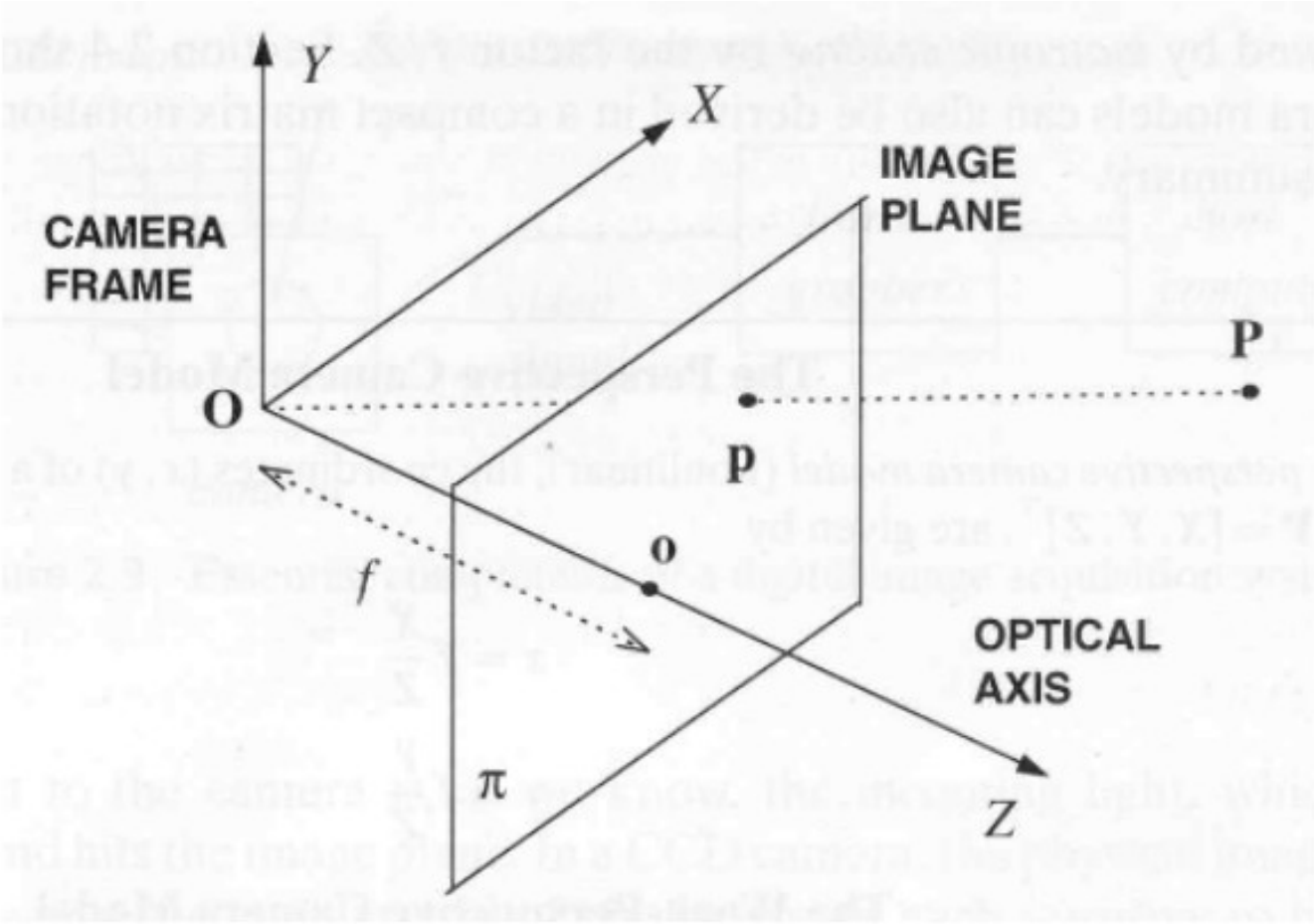

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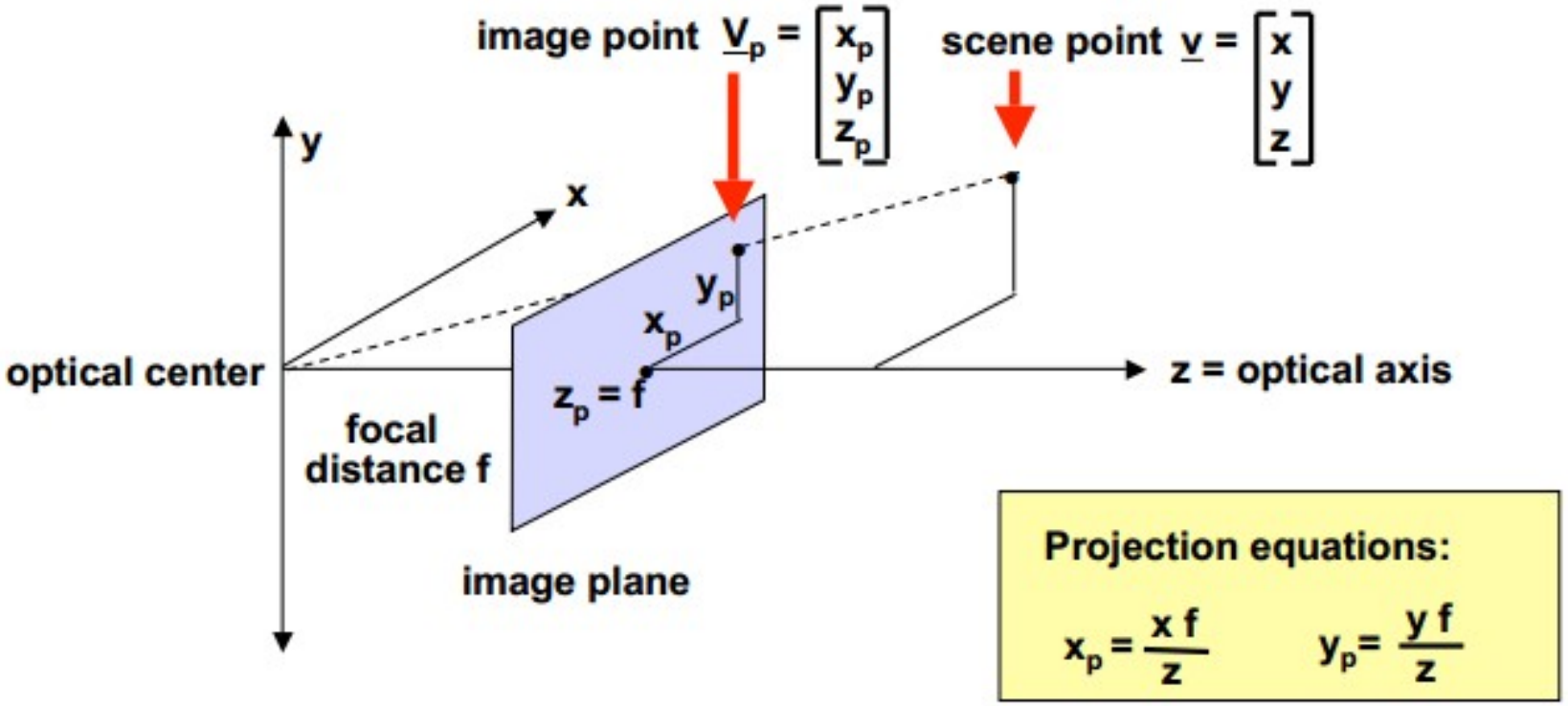

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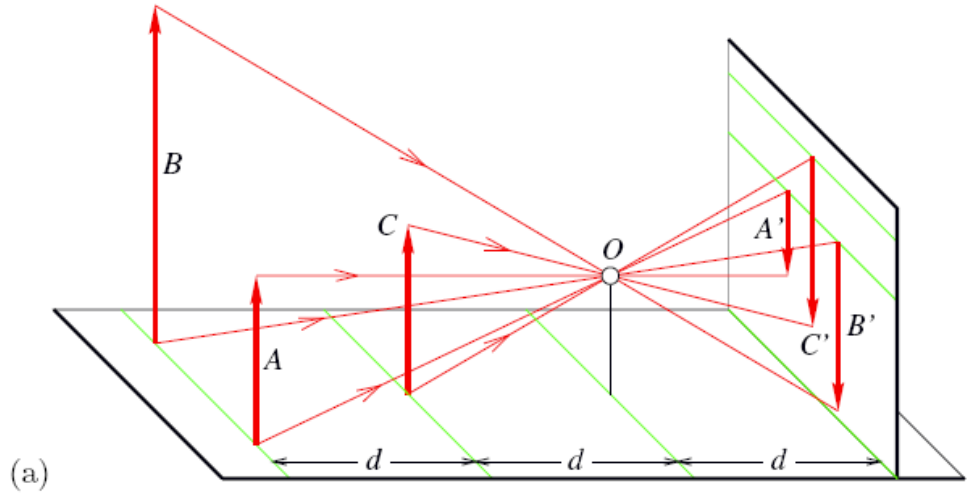

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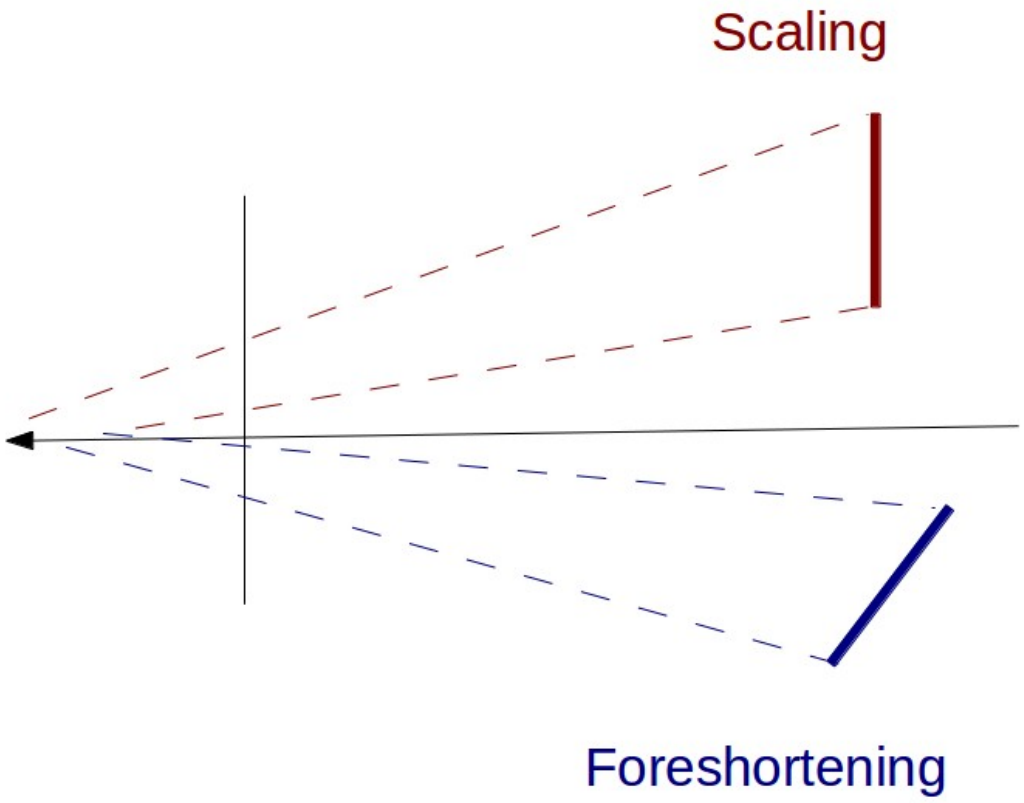

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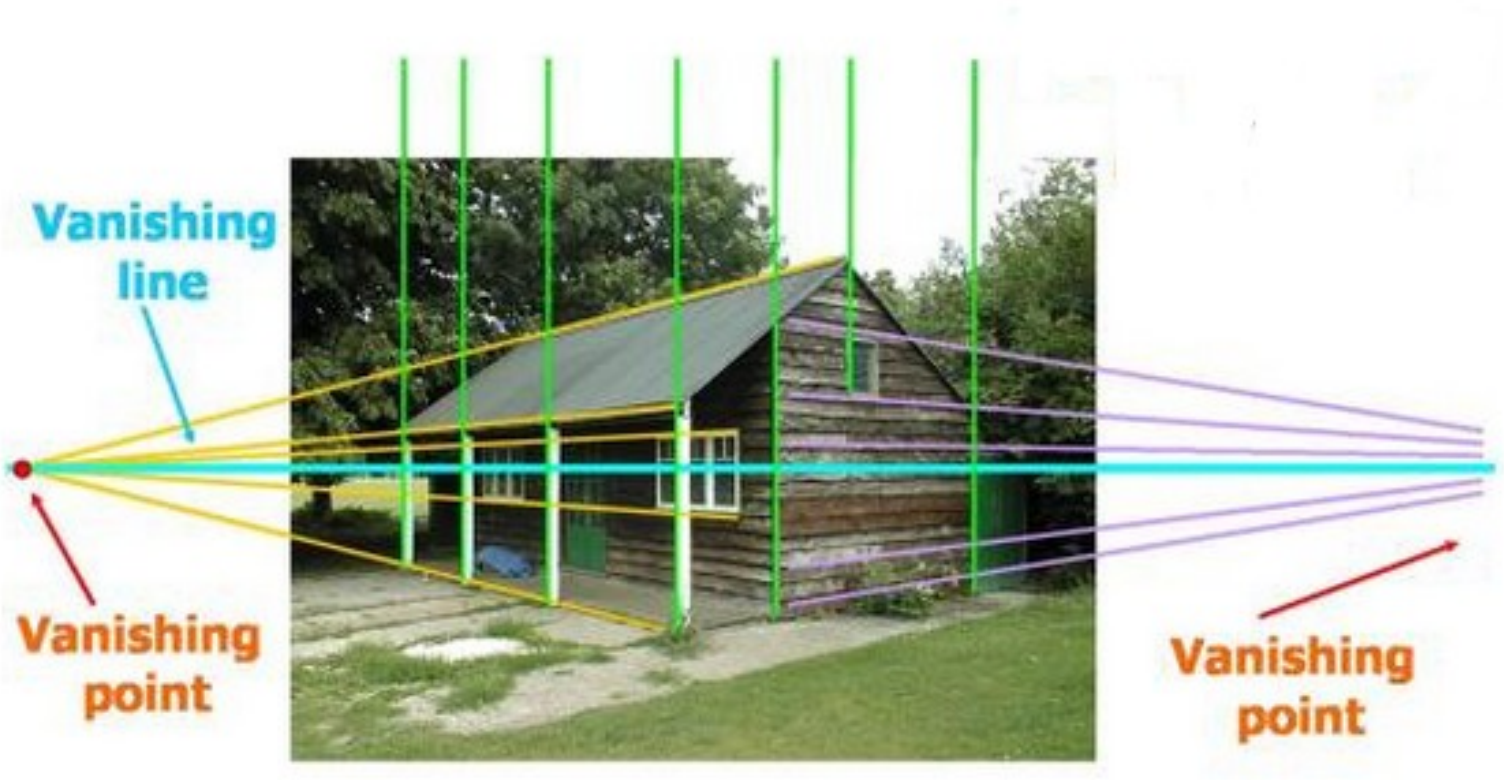

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pinhole diameter $d = 2\sqrt{f' \lambda}$

Example: If *f' = 50mm,*

= 600nm (red),

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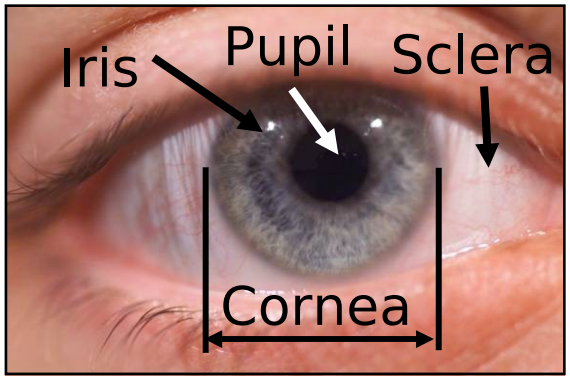
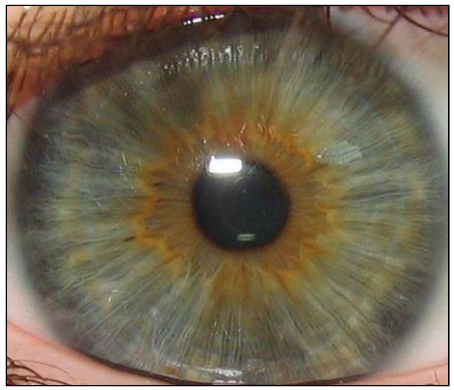
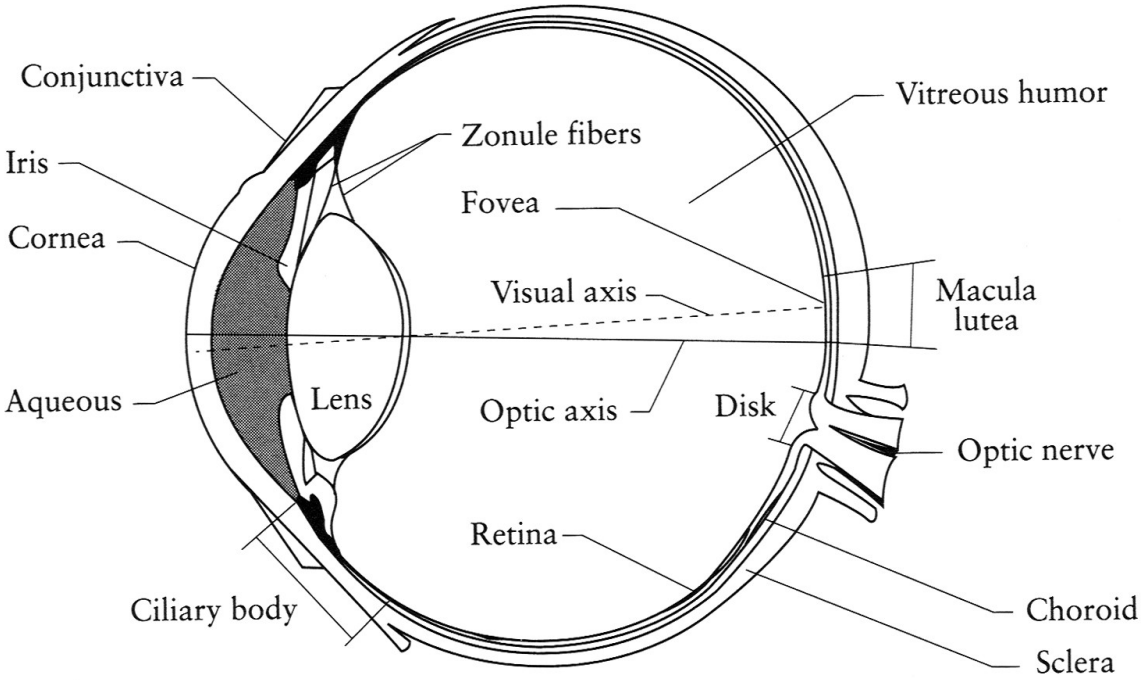
Our Eyes



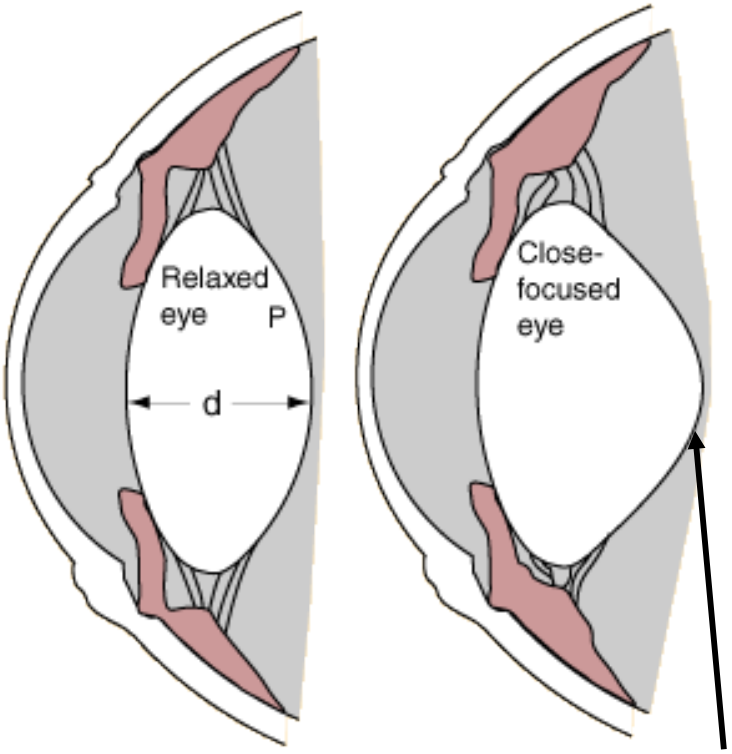


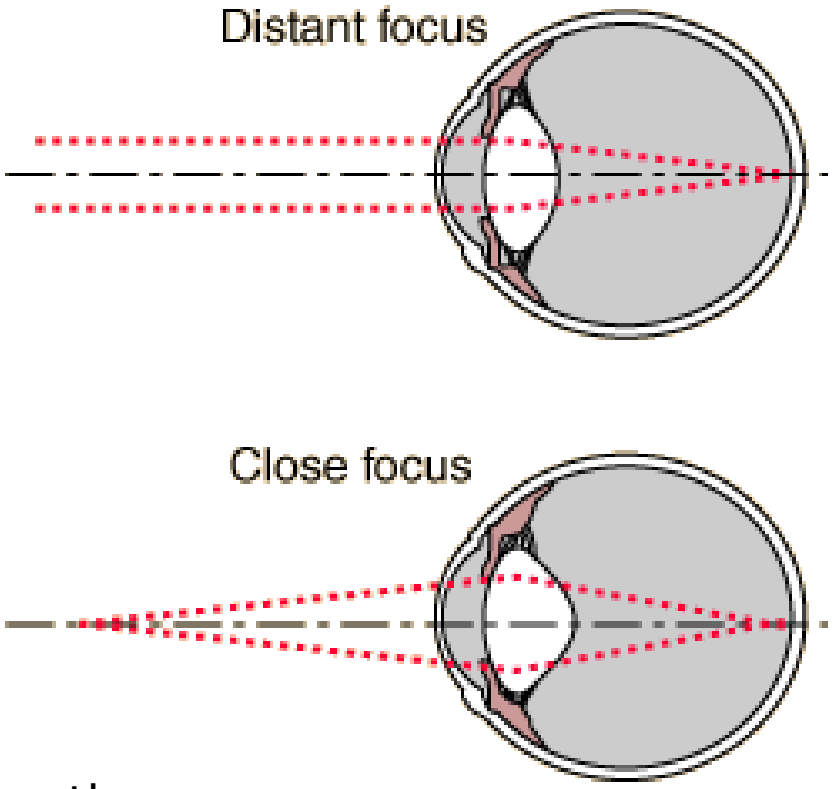


-Iris is the diaphragm that changes the aperture (pupil)

-Retina is the sensor where the fovea has the highest resolution

Focusing

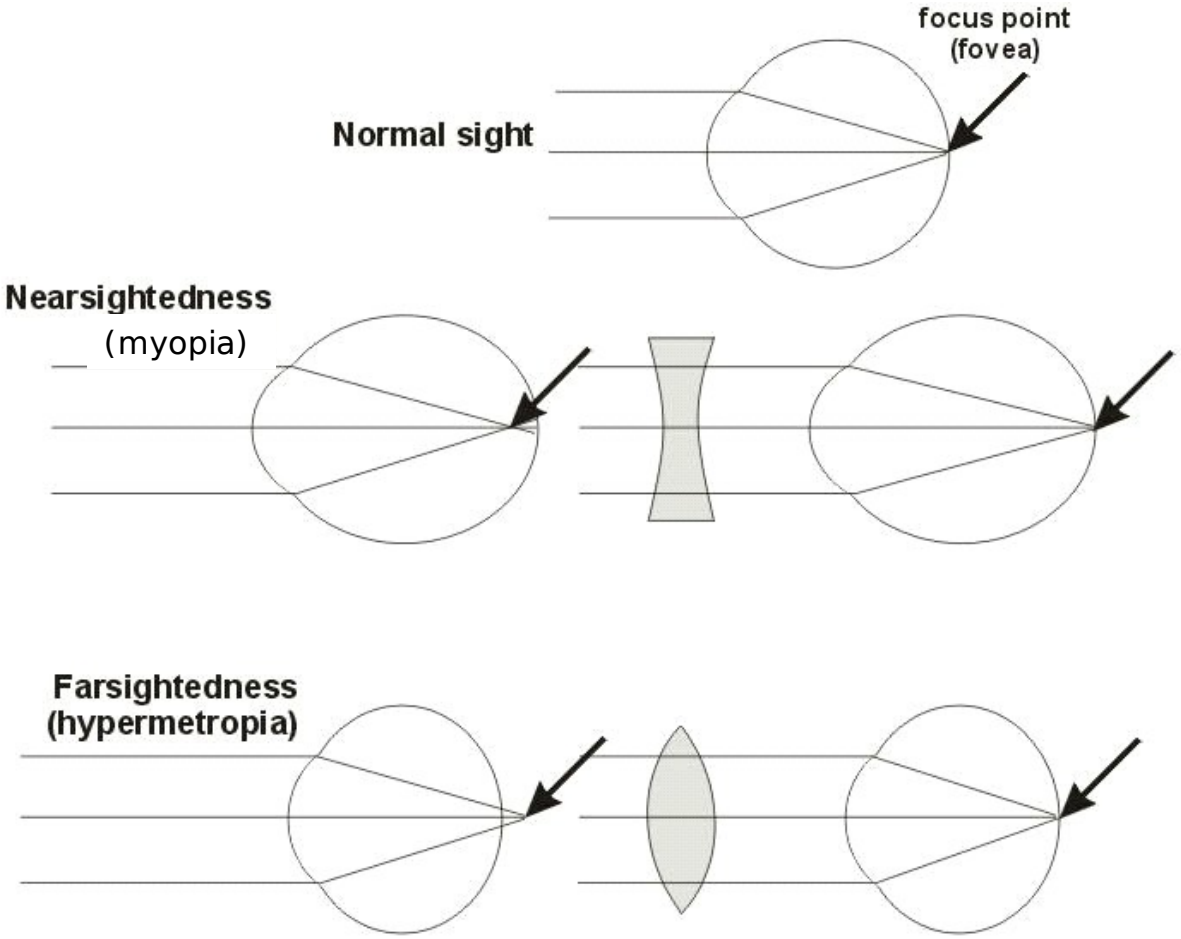




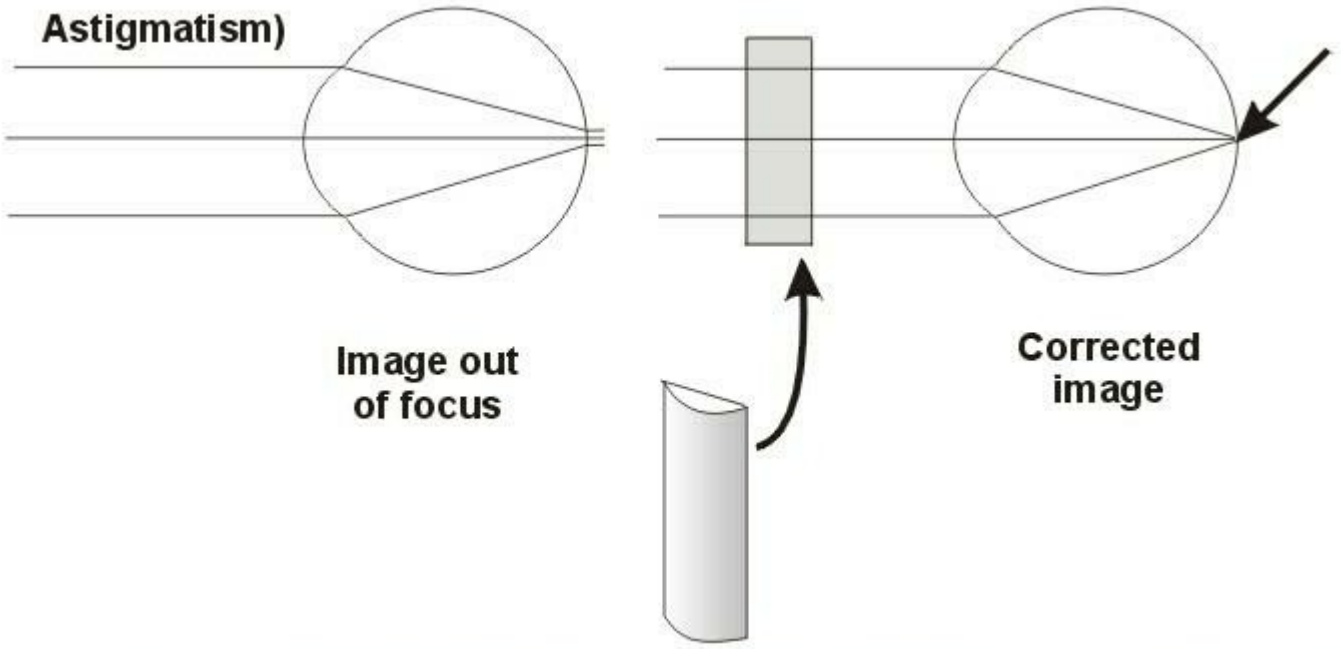
shorter focal length

Changes the focal length of the lens

Myopia and Hyperopia



Astigmatism



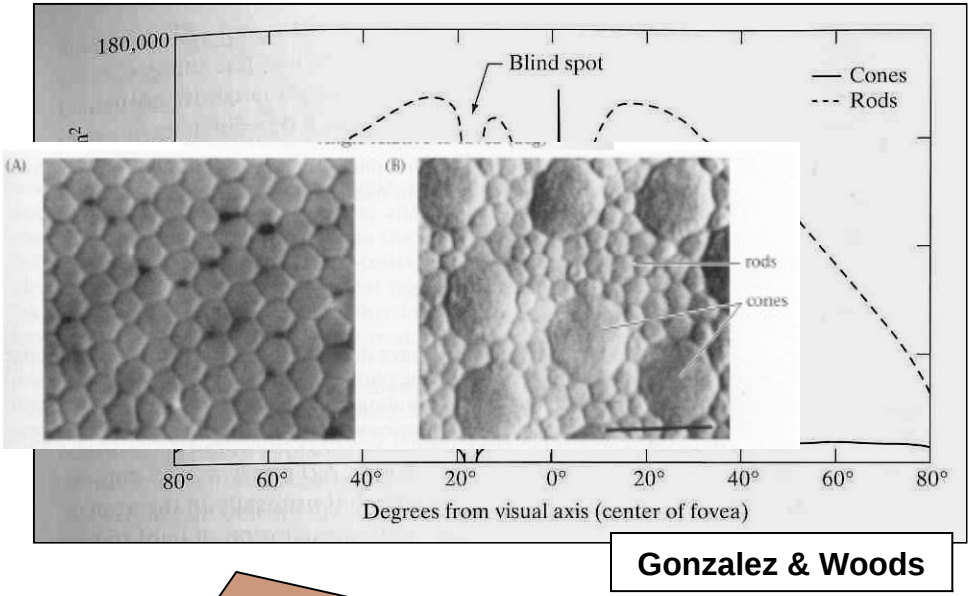
The cornea is distorted causing images to be un-focused on the retina.

Blind Spot in the Eye

Close your right eye and look directly at the “+”

Colour

- Our retina has:
  - **Cones** – Measure the frequency of light (colour)
    - 6 to 7 millions
    - High-definition
    - Need high luminosity
  - **Rods** – Measure the intensity of light (luminance)
    - 75 to 150 millions
    - Low-definition
    - Function with low luminosity



Gonzalez & Woods

We only see colour in the center of our retina!

Resources

- J.C. Russ – Chapters 1 and 2
- Gonzalez & Woods – Chapter 1
- L. Shapiro, and G. Stockman – Chapter 1
- “Color Vision: One of Nature's Wonders” in http://www.diycalculator.com/sp-cvision.shtml

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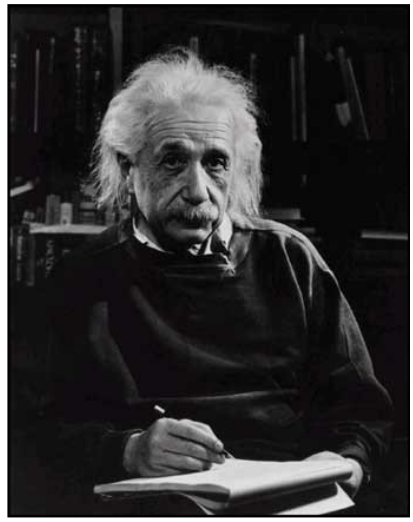

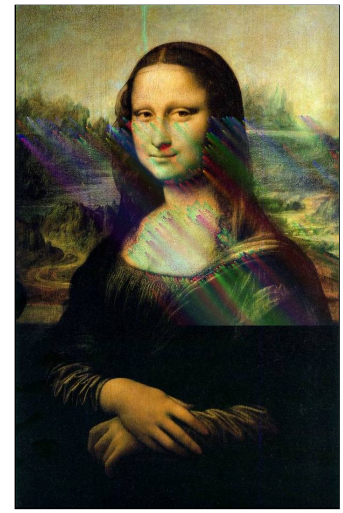

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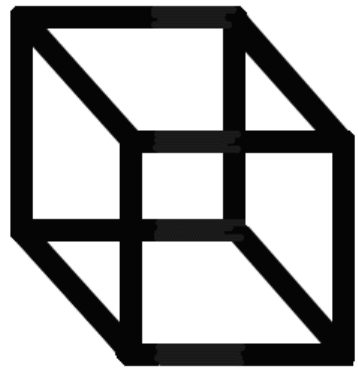

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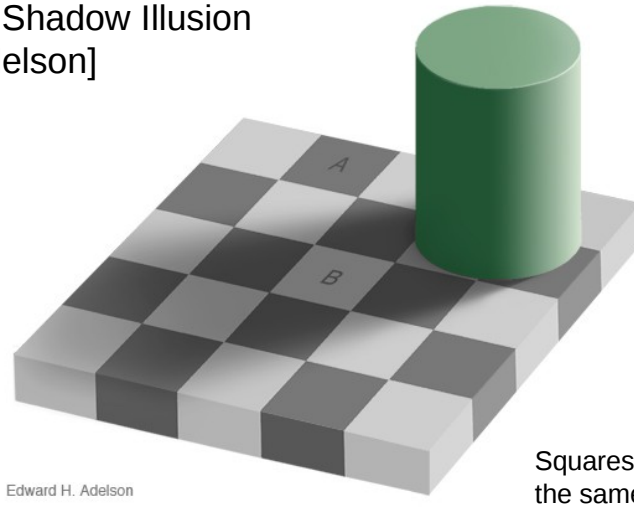

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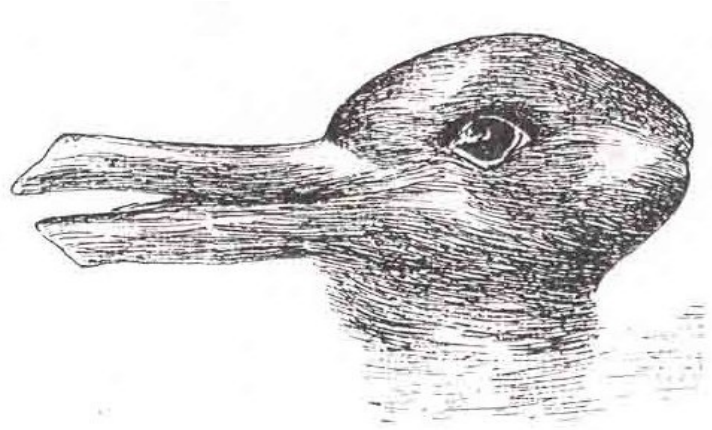

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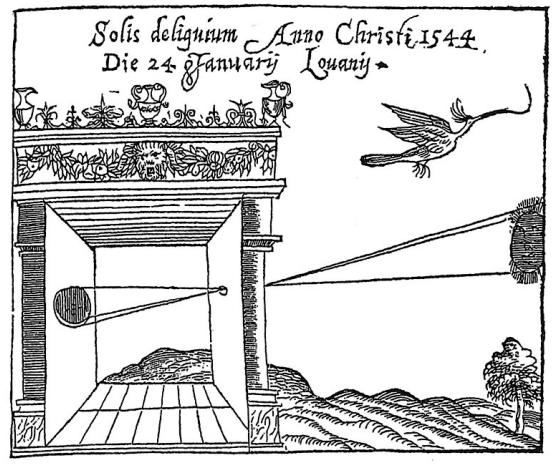

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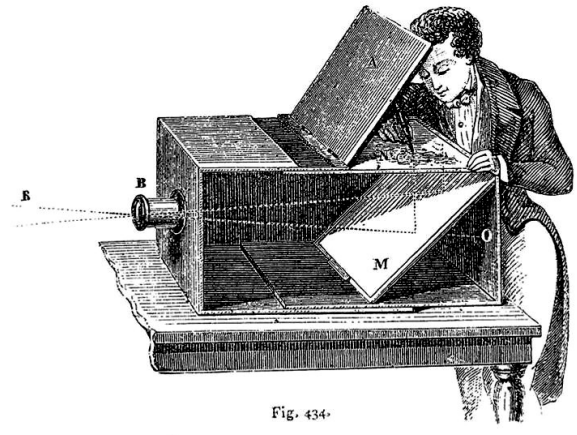
A Brief History of Cameras



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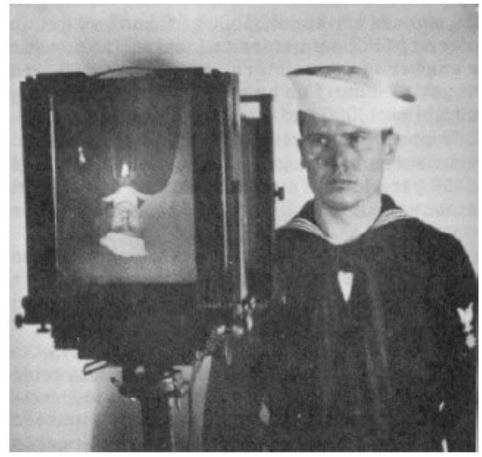

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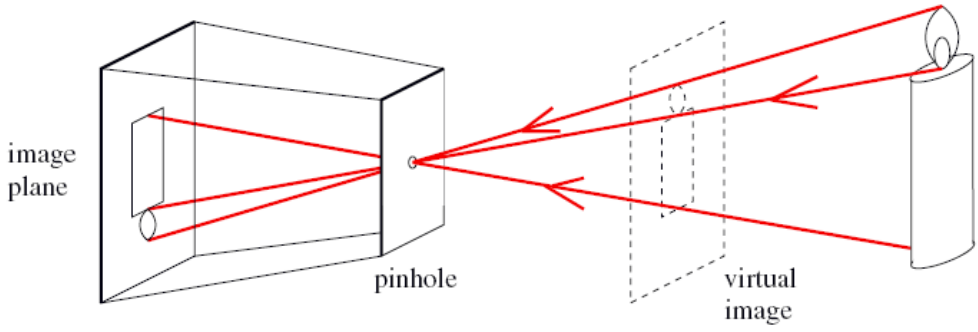
Pinhole Camera Model



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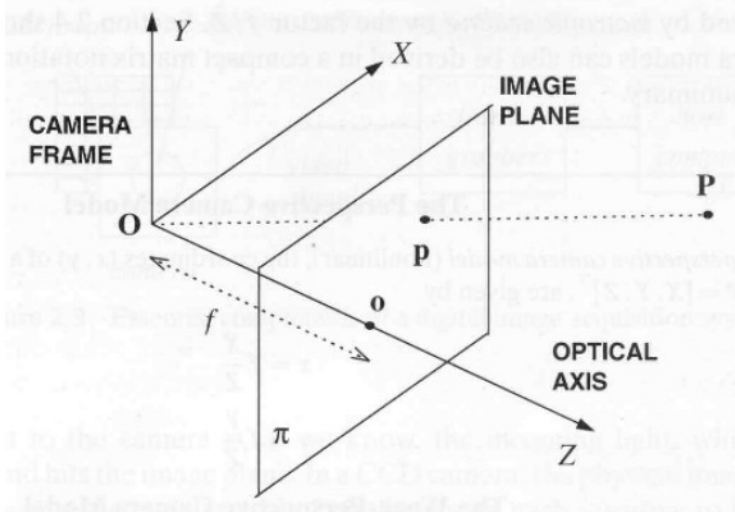

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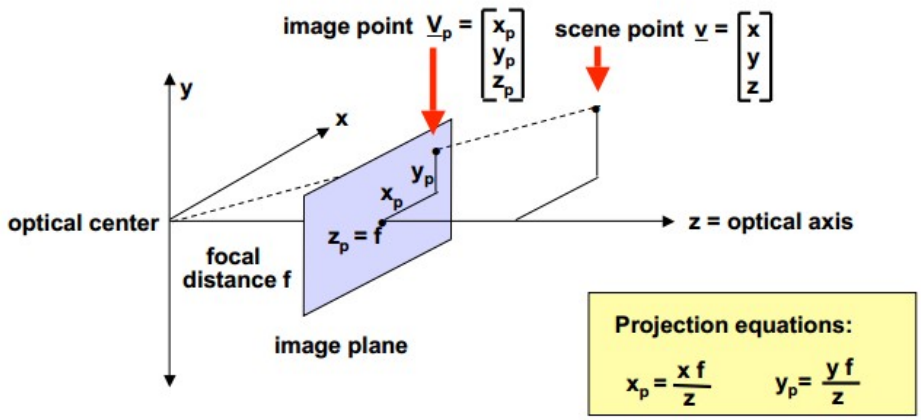

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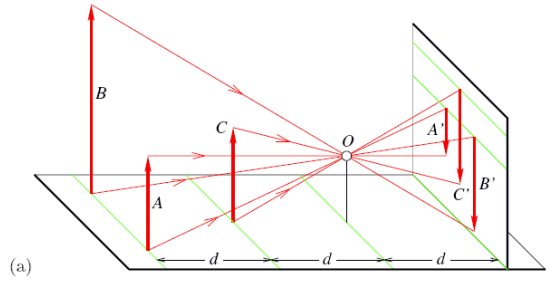

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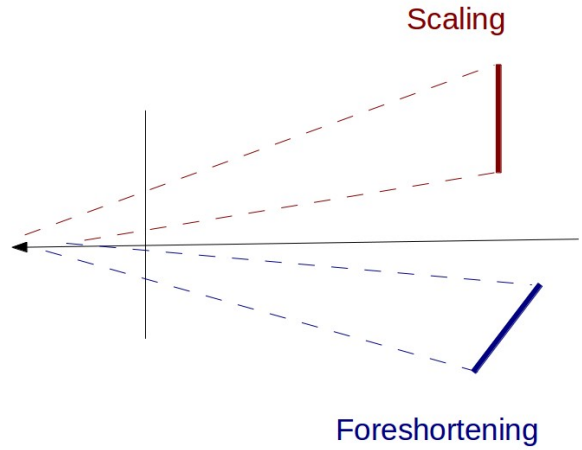

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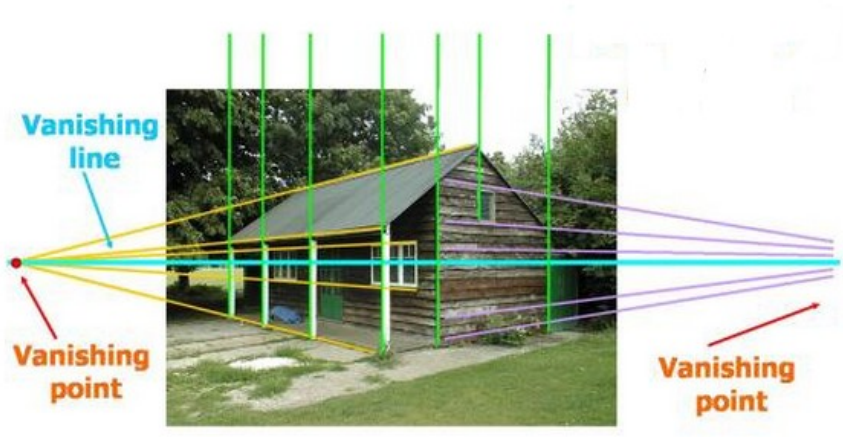

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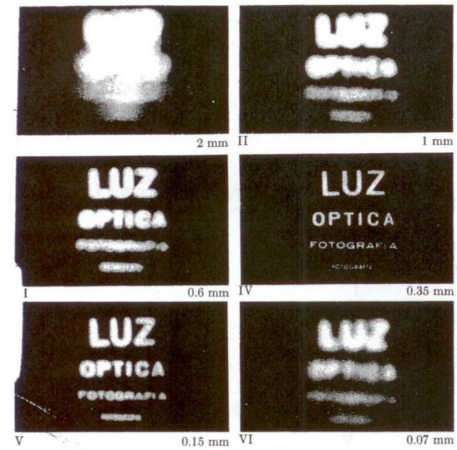

Fig. 5.96 The pinhole camera. Note the variation in image clarity as the hole diameter decreases. [Photos courtesy Dr. N. Joel, UNESCO.]

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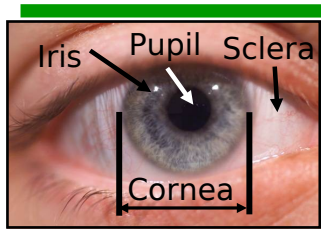

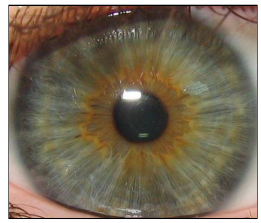

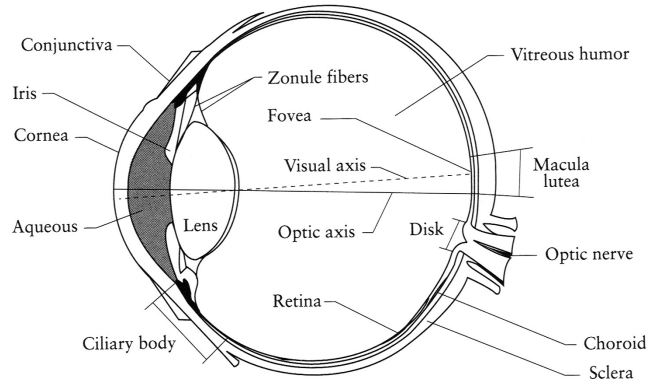

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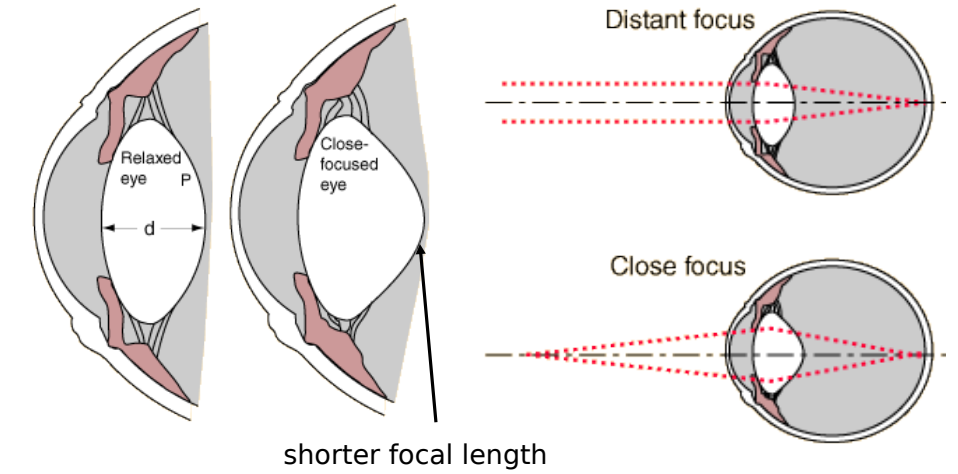
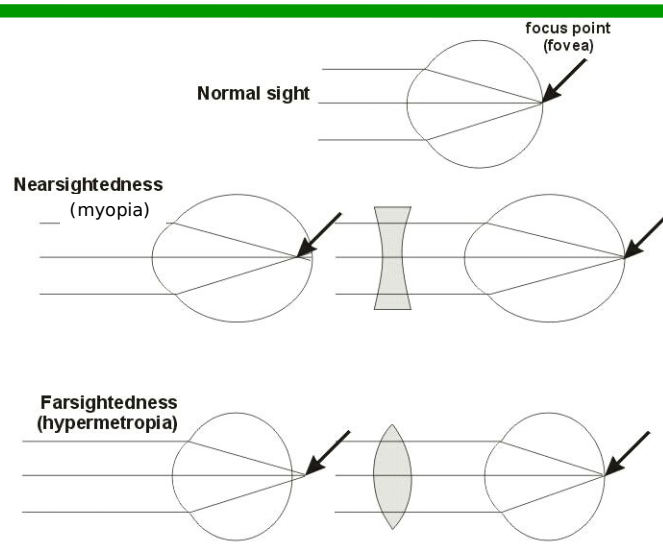


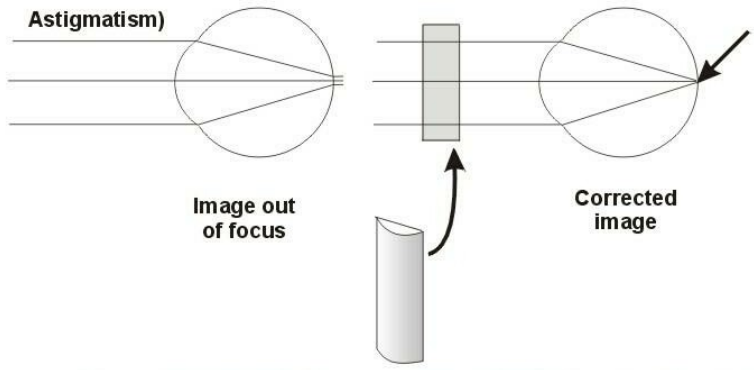
shorter focal length

Changes the focal length of the lens

Myopia and Hyperopia



Astigmatism



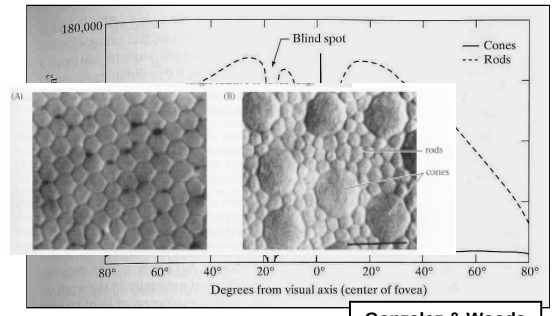
The cornea is distorted causing images to be un-focused on the retina.

Blind Spot in the Eye

Close your right eye and look directly at the “+”

Colour

- Our retina has:
  - **Cones** – Measure the frequency of light (colour)
    - 6 to 7 millions
    - High-definition
    - Need high luminosity
  - **Rods** – Measure the intensity of light (luminance)
    - 75 to 150 millions
    - Low-definition
    - Function with low luminosity



Gonzalez & Woods

We only see colour in the center of our retina!

Resources

- J.C. Russ – Chapters 1 and 2
- Gonzalez & Woods – Chapter 1
- L. Shapiro, and G. Stockman – Chapter 1
- “Color Vision: One of Nature's Wonders” in http://www.diycalculator.com/sp-cvision.shtml