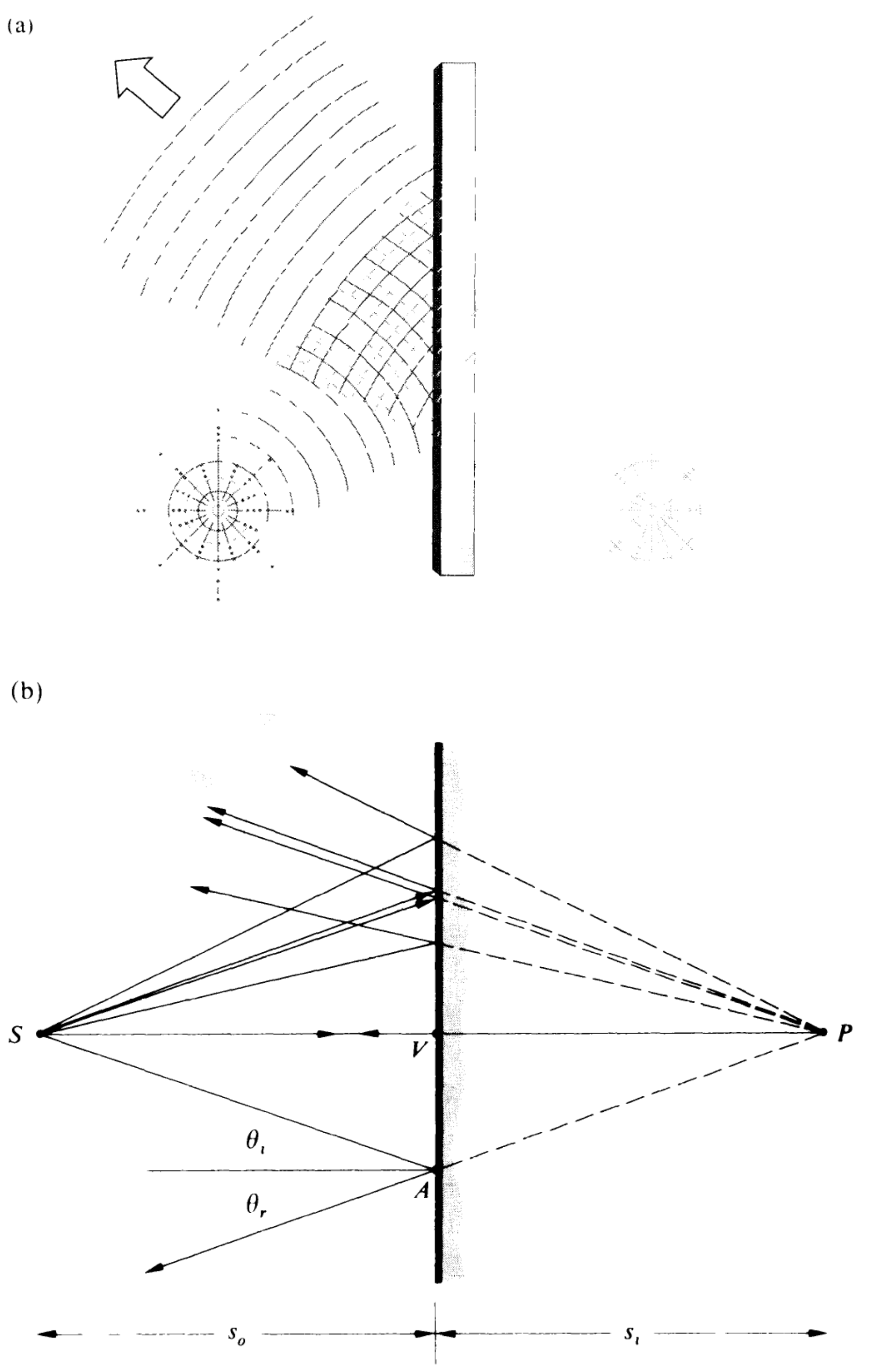
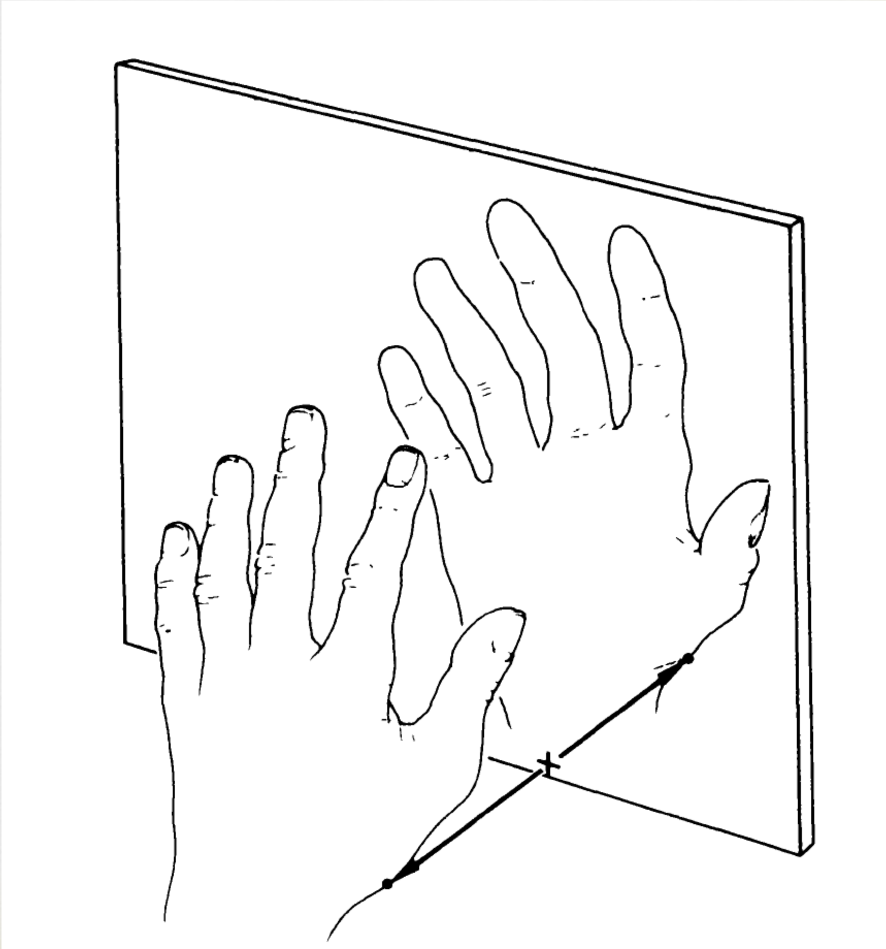
PHYS 3038 Optics
L6 Geometrical Optics
Reading Material: Ch5.4-5.9

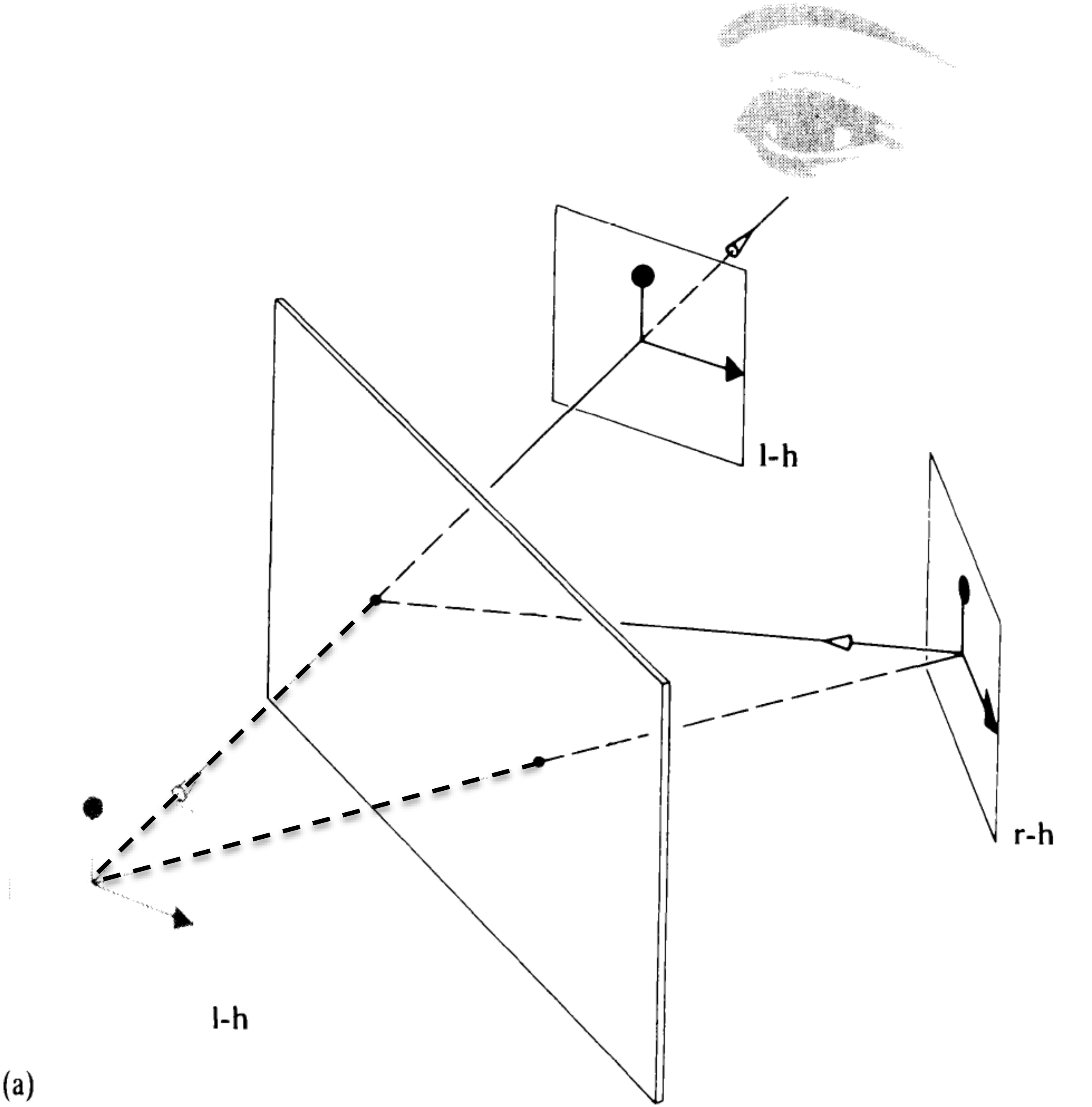
Shengwang Du

2015, the Year of Light

5.4.1 Planar Mirrors







(a)

The ability to rapidly redirect a beam o
virtue of planar mirrors that has been utiliz
single-lens reflex camera (see photo on

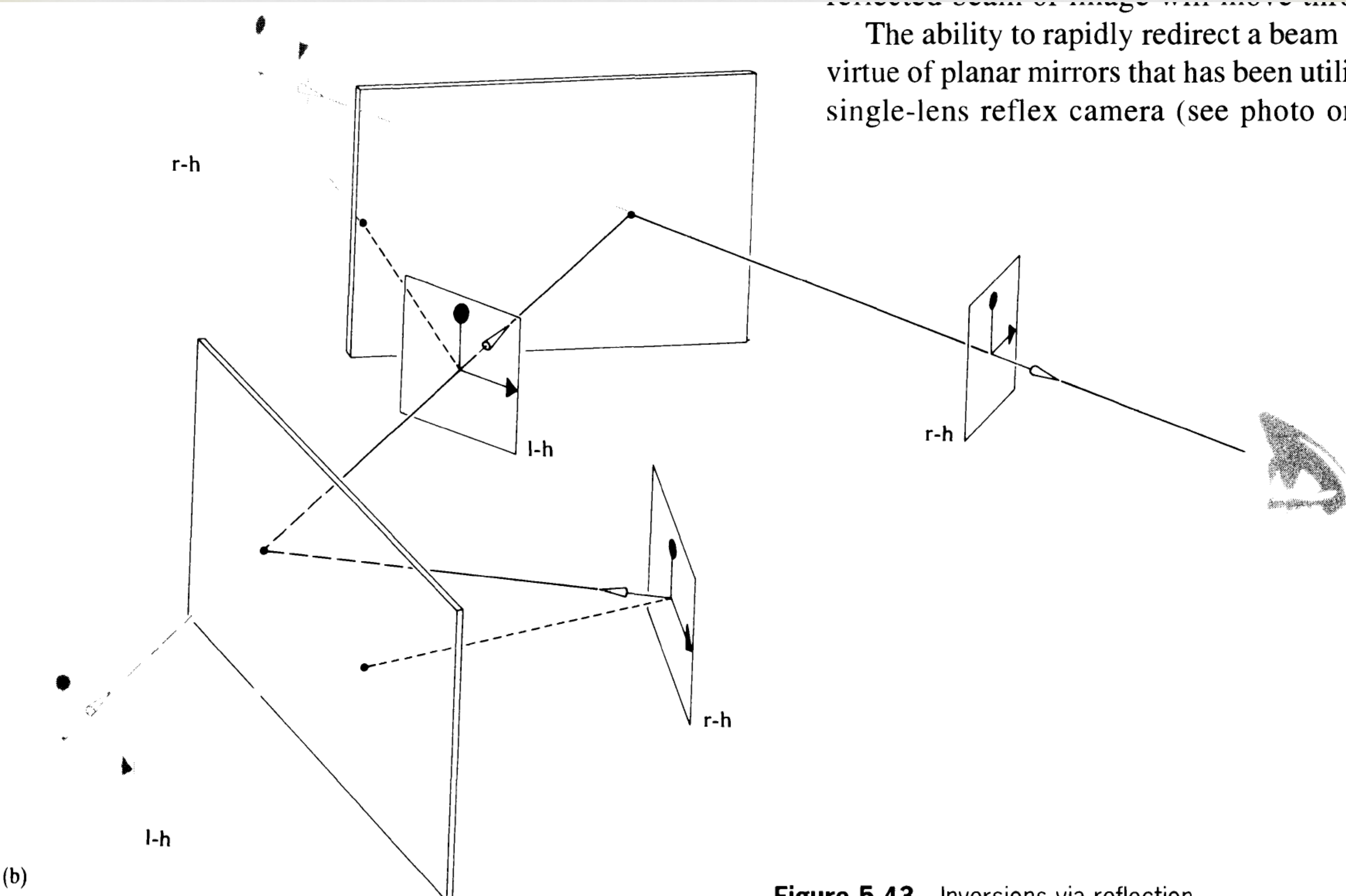


Figure 5.43 Inversions via reflection.

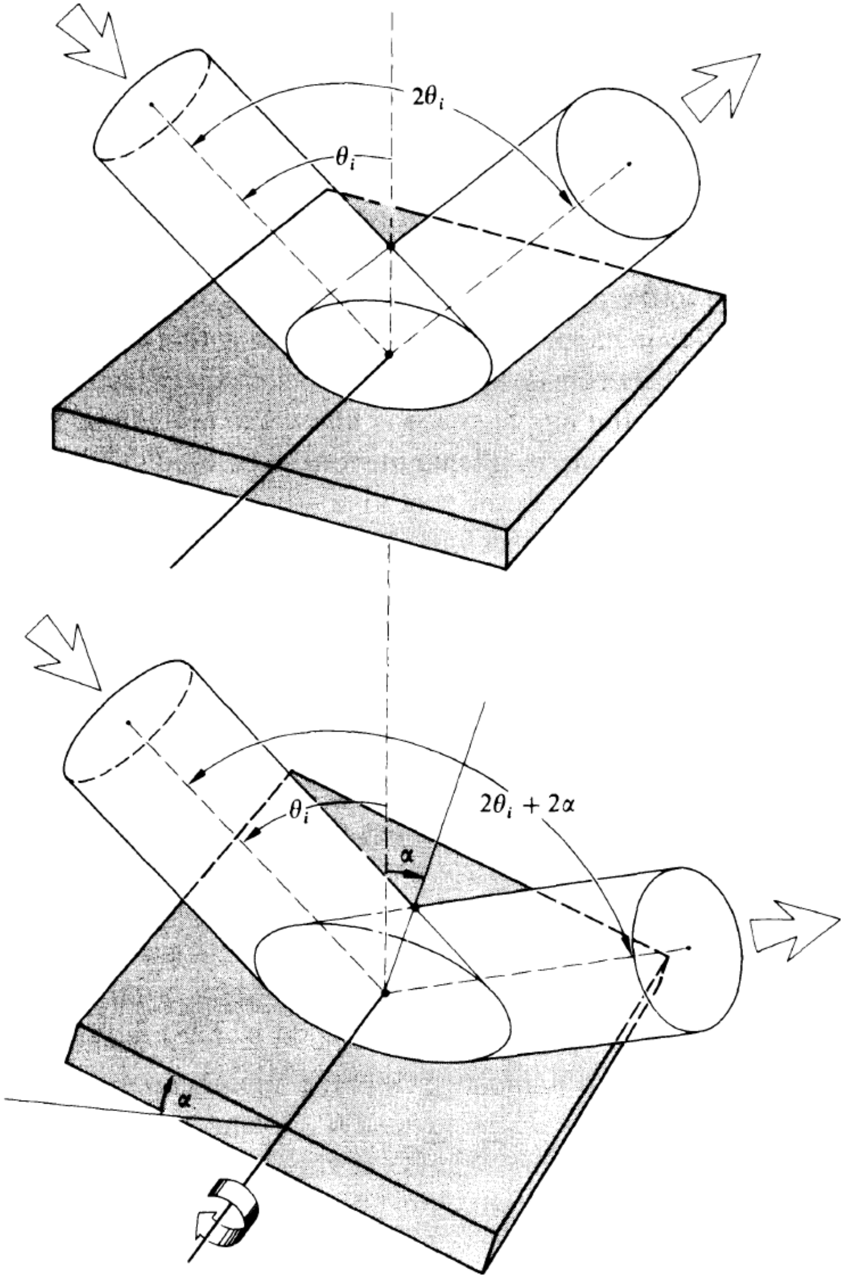
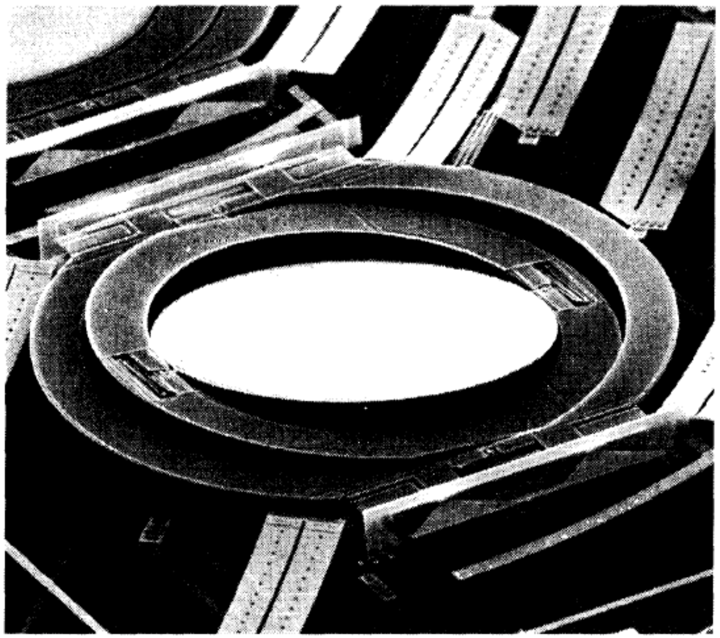


Figure 5.44 Rotation of a mirror and the concomitant angular displacement of a beam.



This tiny tiltable mirror (which is so small it can fit through the eye of a needle) is used to steer light beams in one of today's most important telecommunications devices. (Photo courtesy Lucent Technologies' Bell Laboratories.)

Aspherical Mirrors

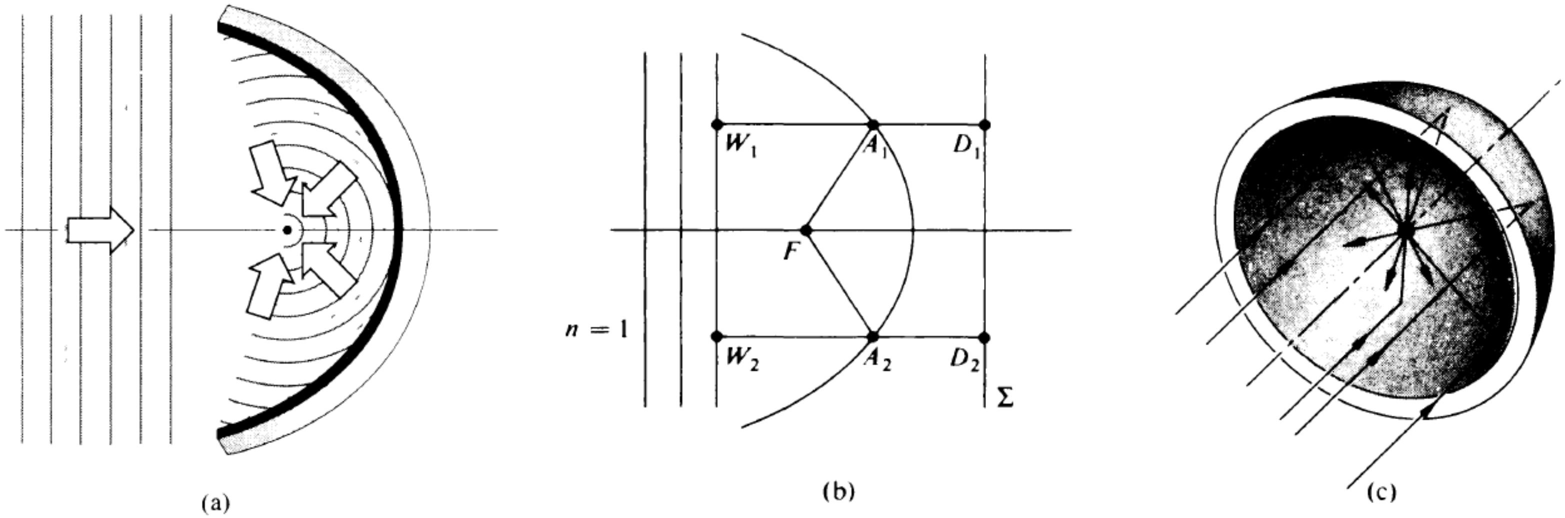


Figure 5.45
A paraboloidal mirror.

$$OPL = \overline{W_1A_1} + \overline{A_1F} = \overline{W_2A_2} + \overline{A_2F}$$

$$\overline{W_1A_1} + \overline{A_1D_1} = \overline{W_2A_2} + \overline{A_2D_2}$$

Paraboloidal Mirror

Aspherical Mirrors

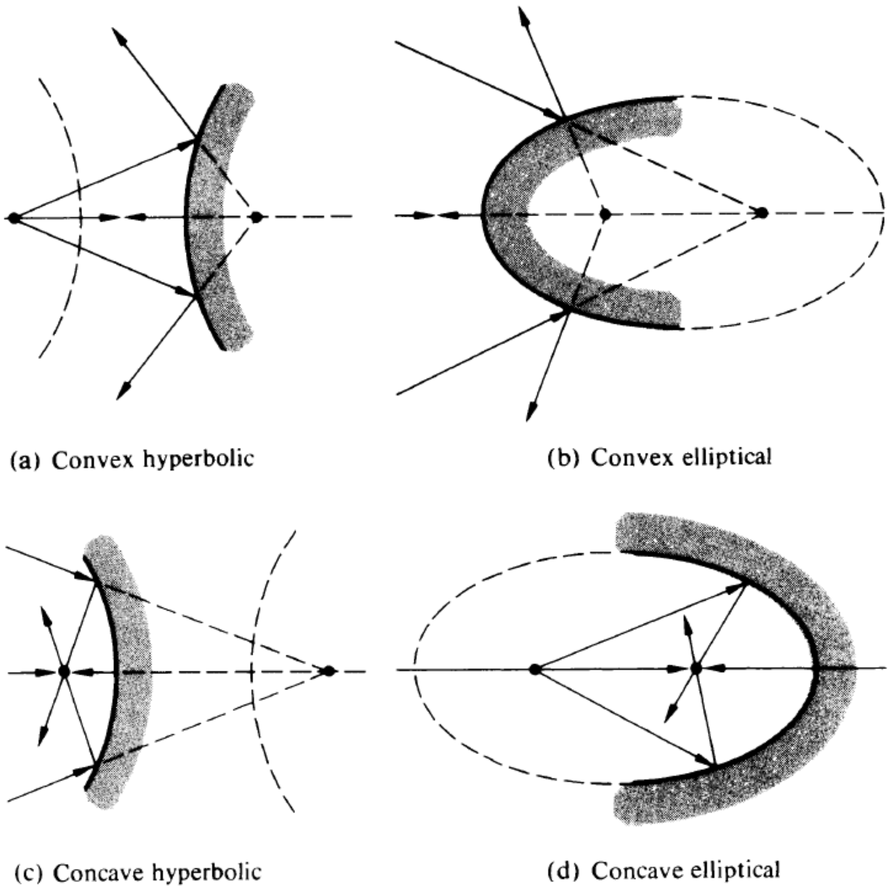
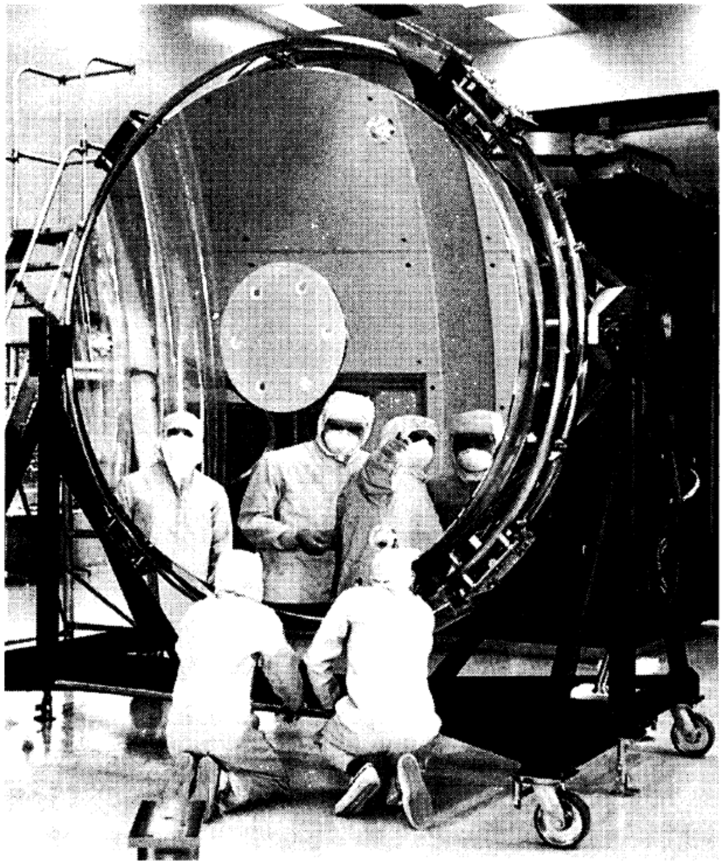


Figure 5.47 Hyperbolic and elliptical mirrors.



The 2.4-m-diameter hyperboloidal primary mirror of the Hubble Space Telescope. (Photo courtesy of NASA.)

5.4.3 Spherical Mirrors

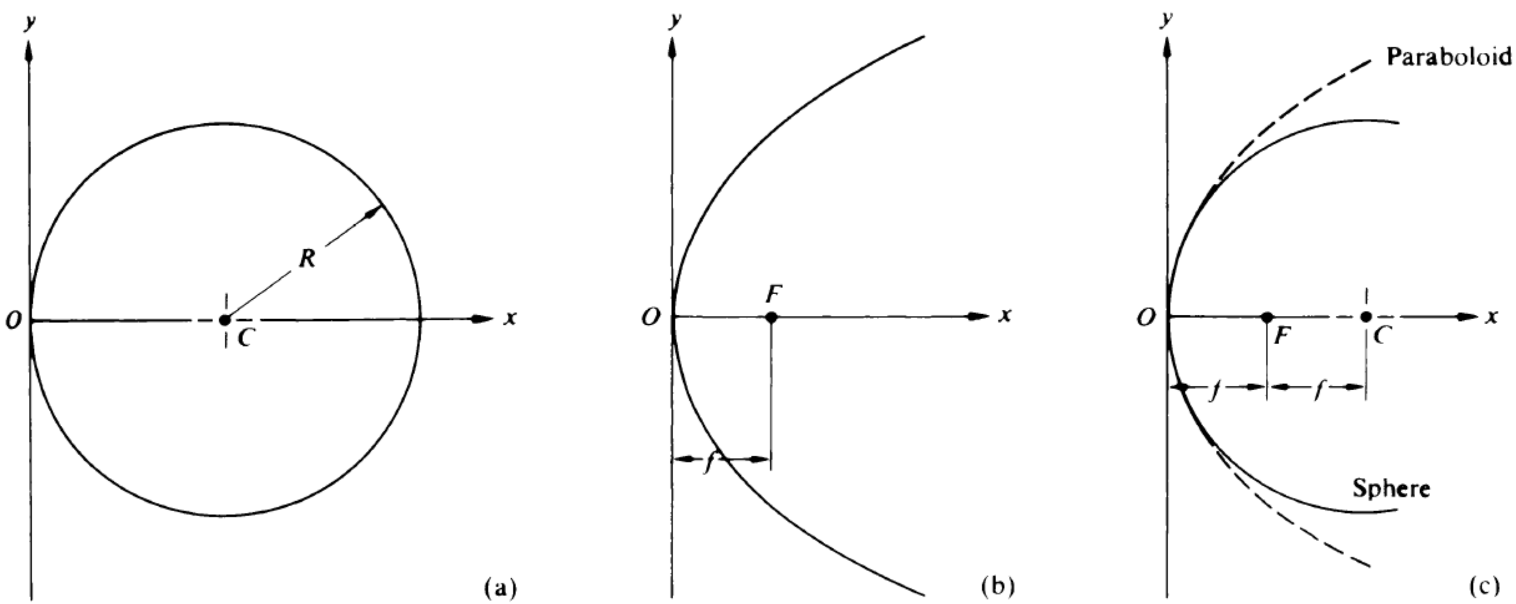
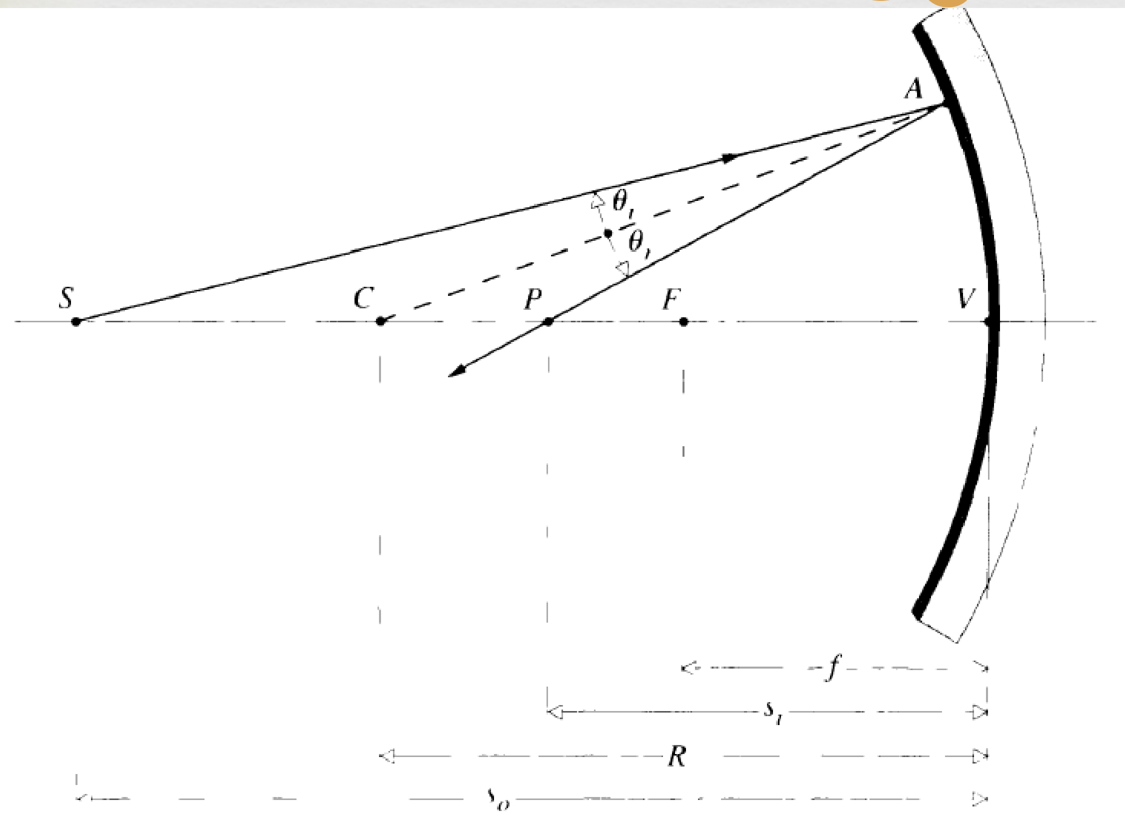


Figure 5.49
Comparison of spherical and paraboloidal mirrors.

Mirror Formula

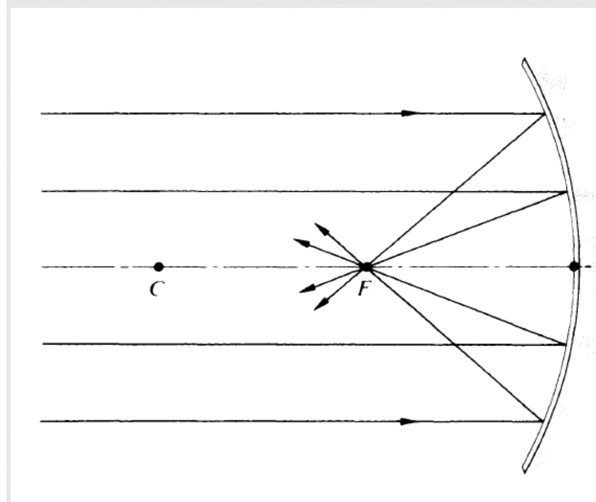


$R < 0$

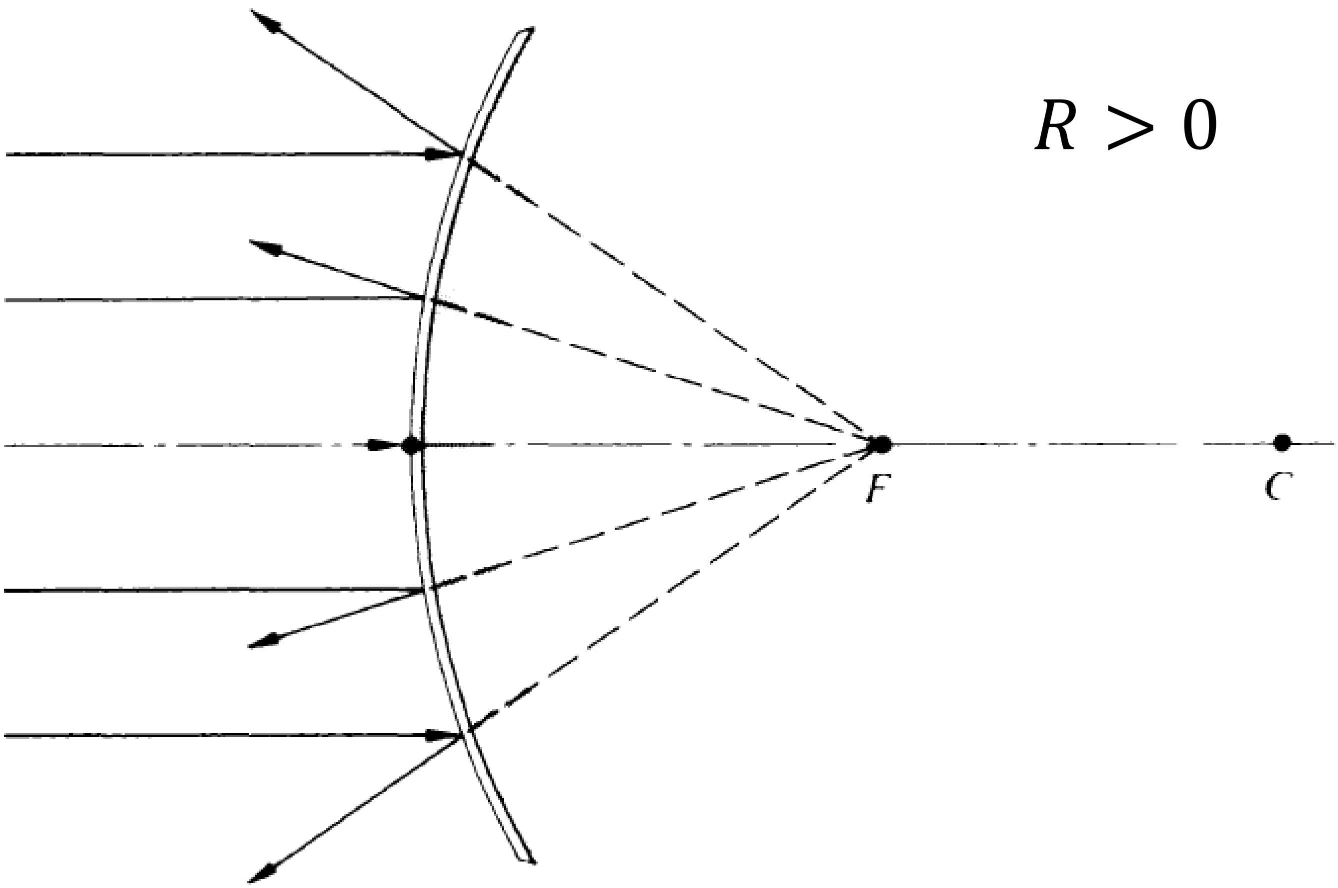
Figure 5.50 A concave spherical mirror. Conjugate foci.

$$\frac{1}{s_o}+\frac{1}{s_i}=\frac{1}{f}$$

$$f=-\frac{R}{2}$$



Negative Focal Length

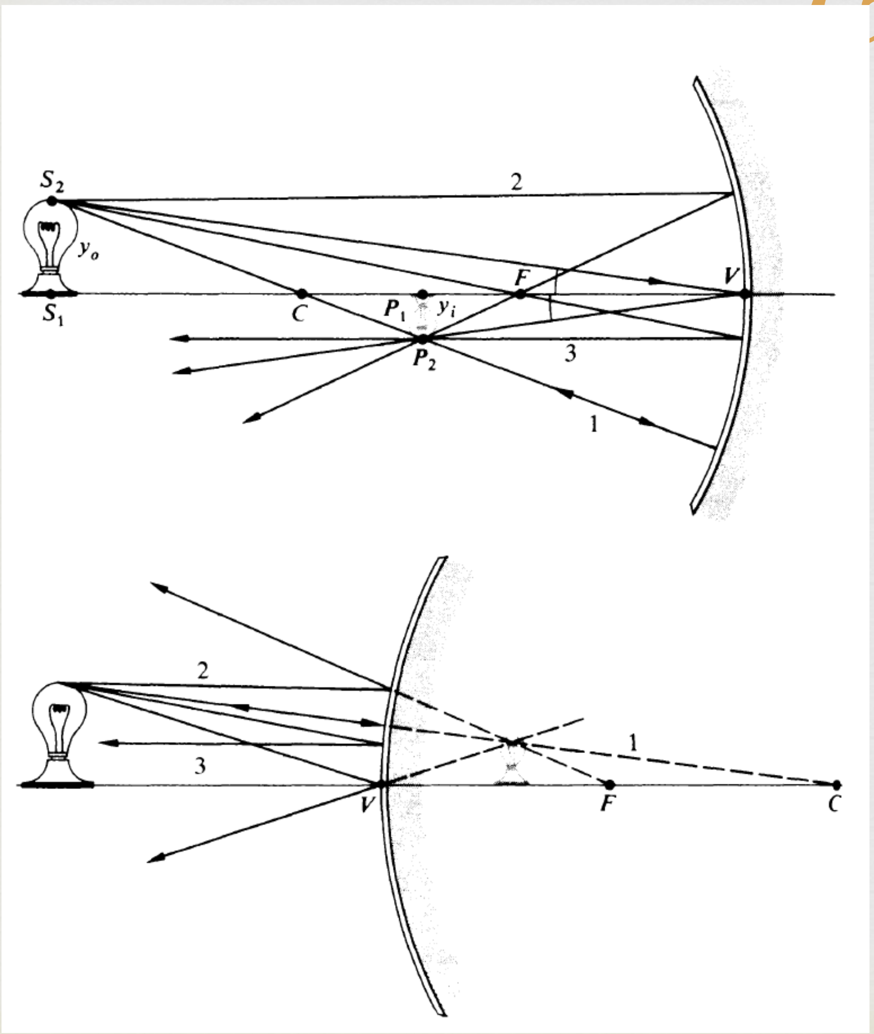


$R > 0$

$$\frac{1}{s_o} + \frac{1}{s_i} = \frac{1}{f}$$

$$f = -\frac{R}{2}$$

Imagery with spherical mirrors



$$\frac{1}{s_o}+\frac{1}{s_i}=\frac{1}{f}$$

$$f=-\frac{R}{2}$$

5.5.1 Dispersing Prisms

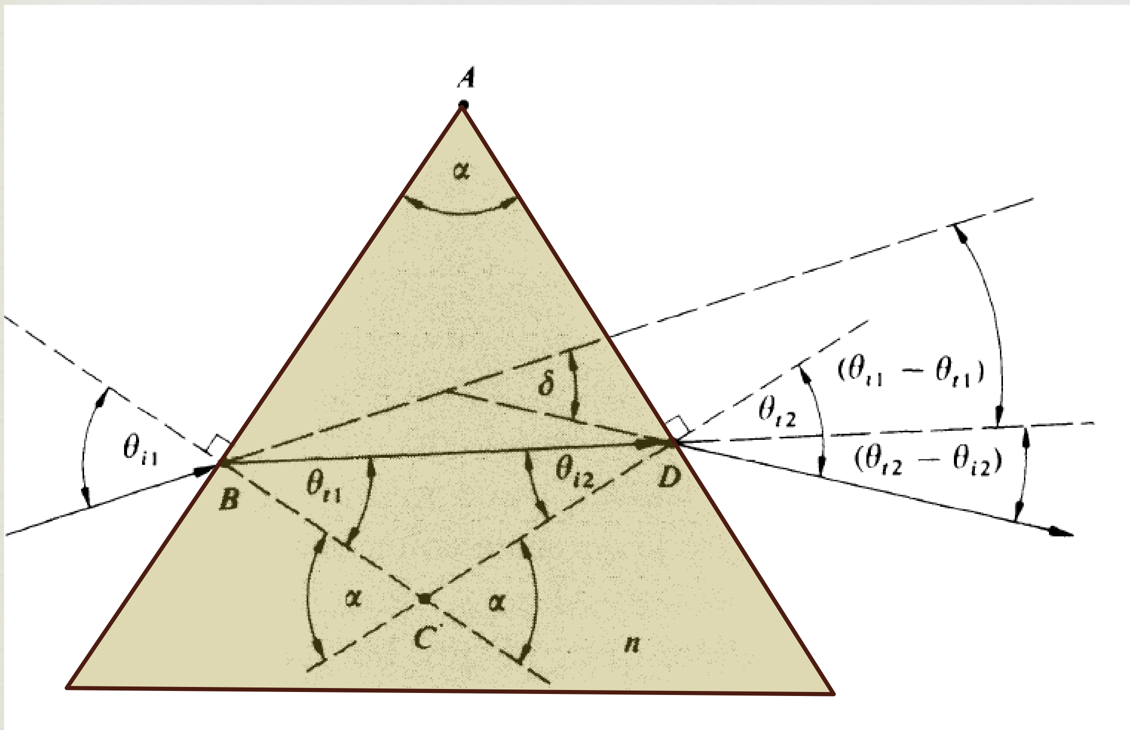
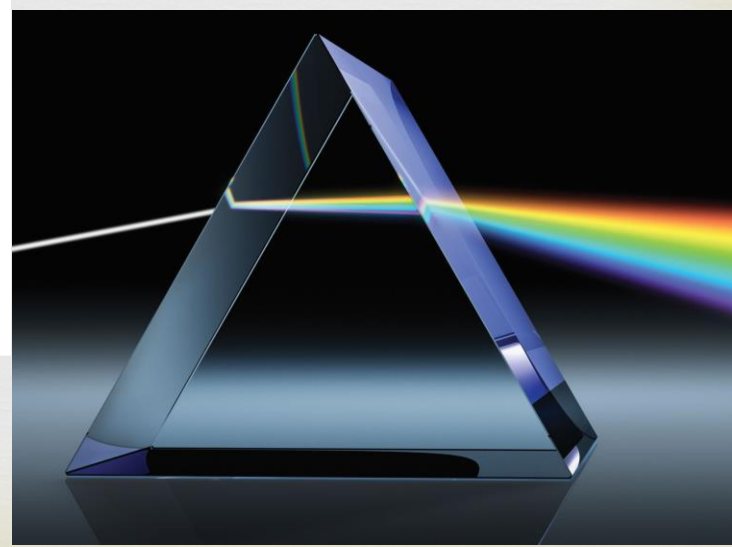


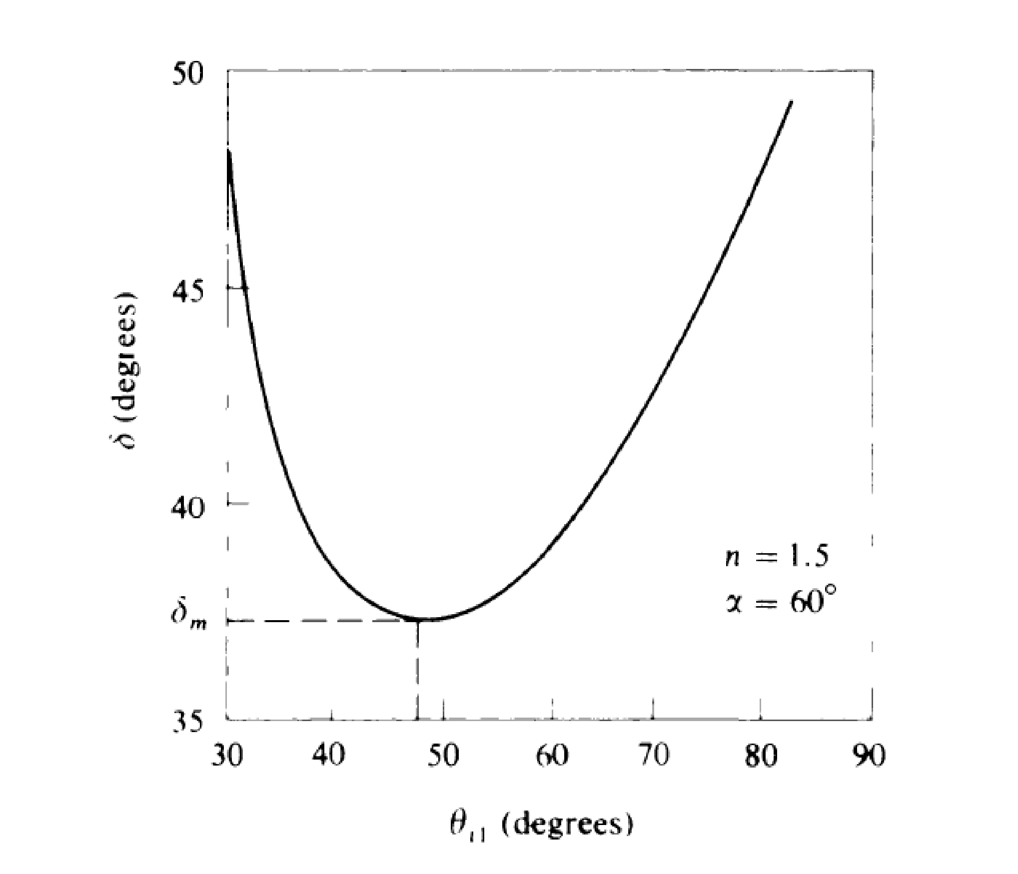
Figure 5.56 Geometry of a dispersing prism

$$\sin\theta_{i1} = n\sin\theta_{t1}$$

$$n\sin\theta_{i2} = \sin\theta_{t2}$$



Dispersing Prims



$$n = \frac{\sin[(\delta_m + \alpha)/2]}{\sin \alpha/2}$$

Constant Deviation Dispersing Prisms

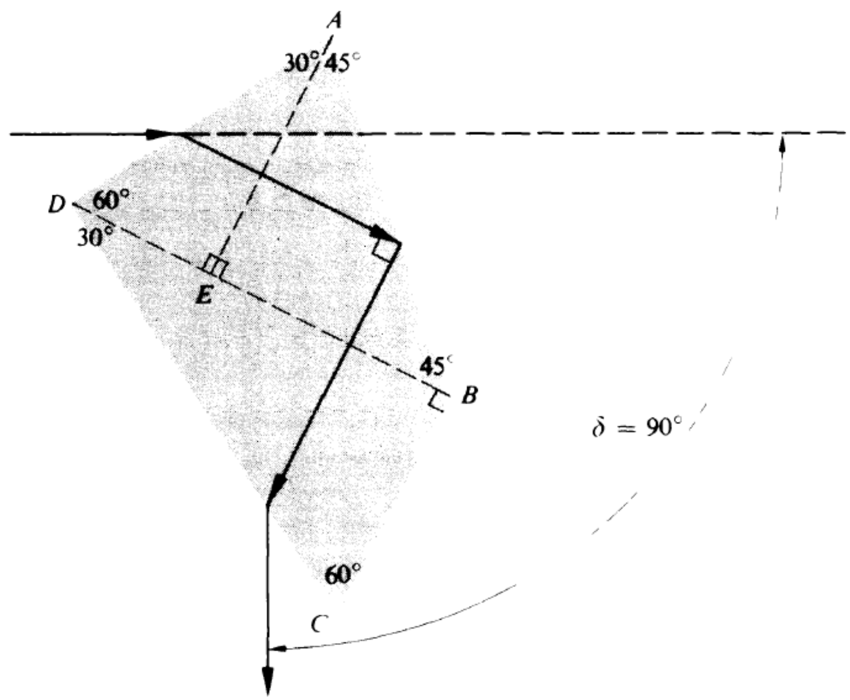


Figure 5.58 The Pellin–Broca prism.

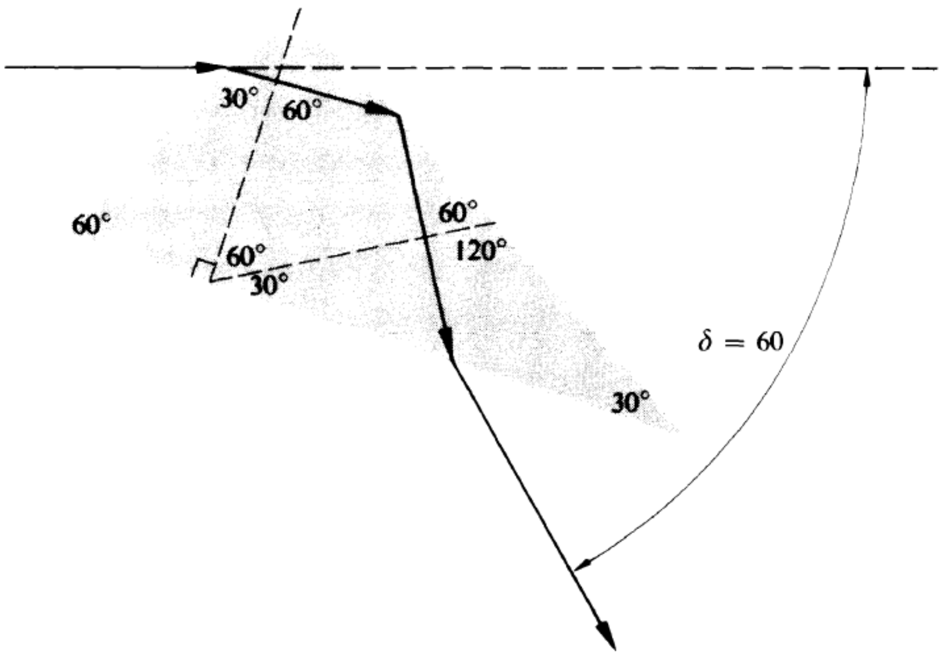
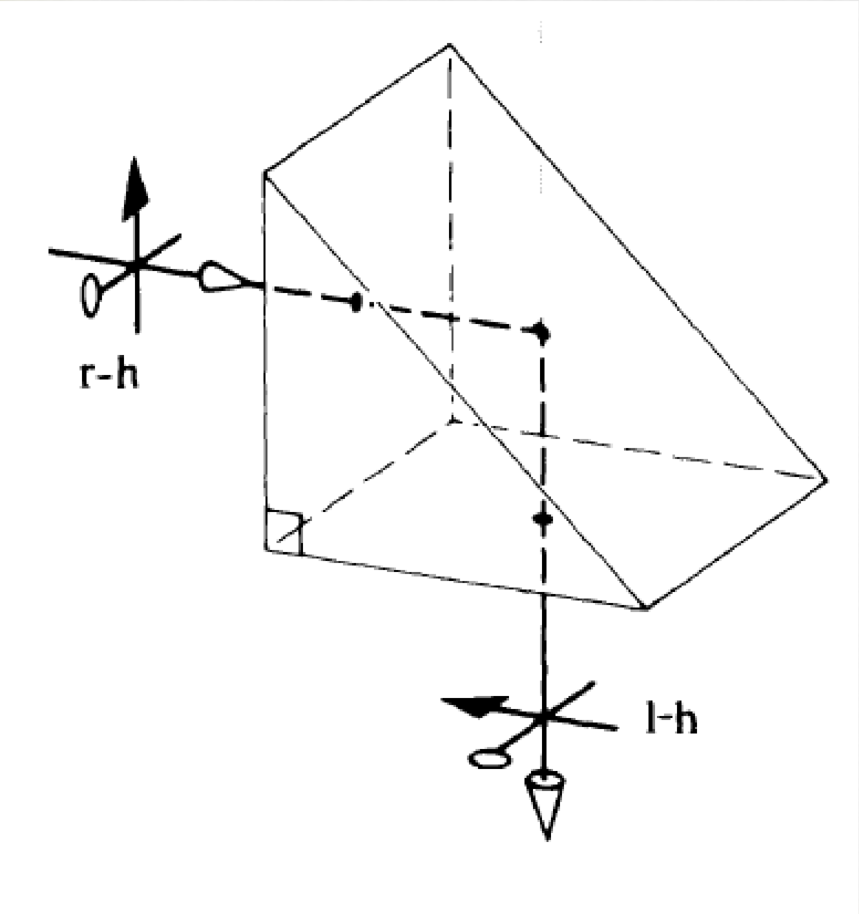
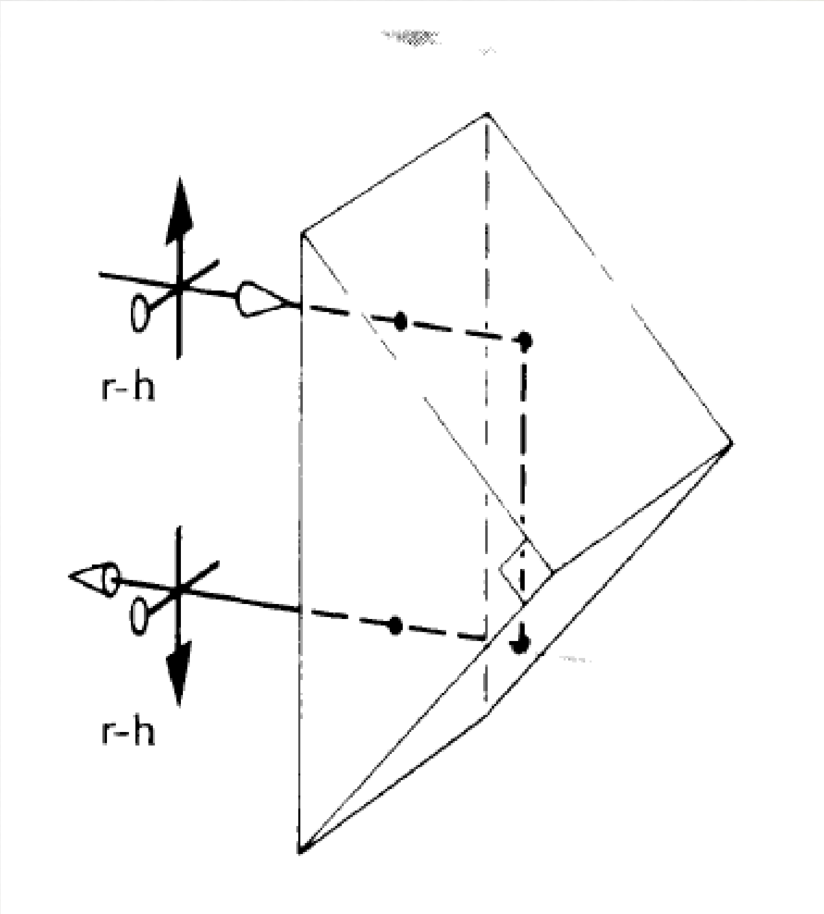


Figure 5.59 The Abbe prism.

5.5.2 Reflecting Prisms (internal reflection without dispersion)





Reflecting Prisms

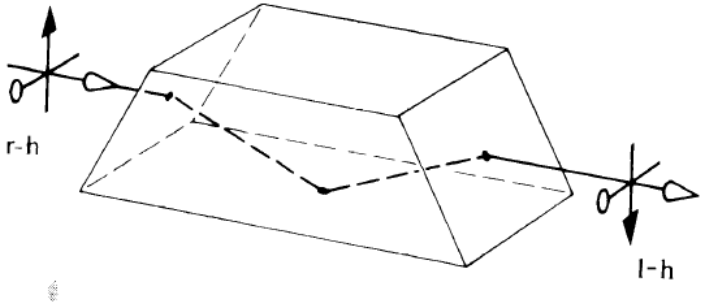
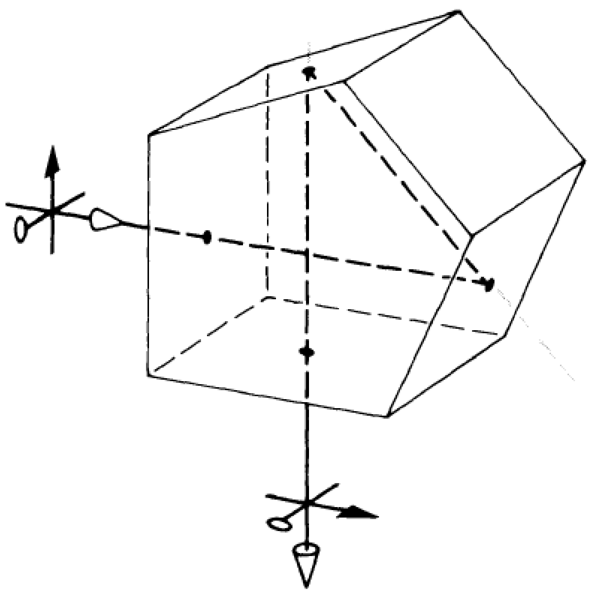
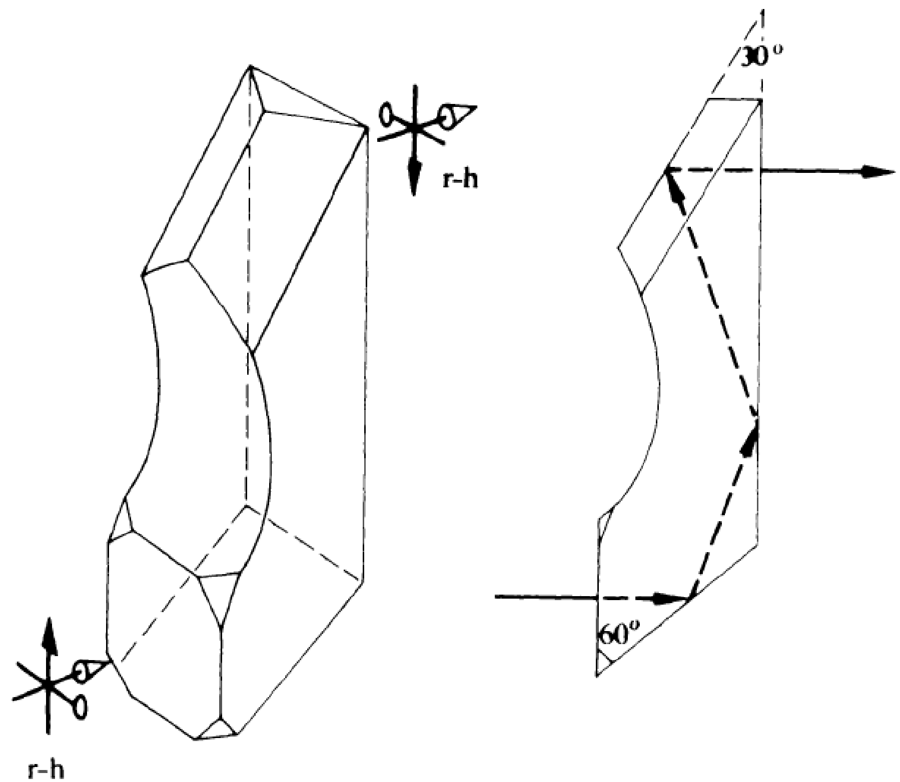
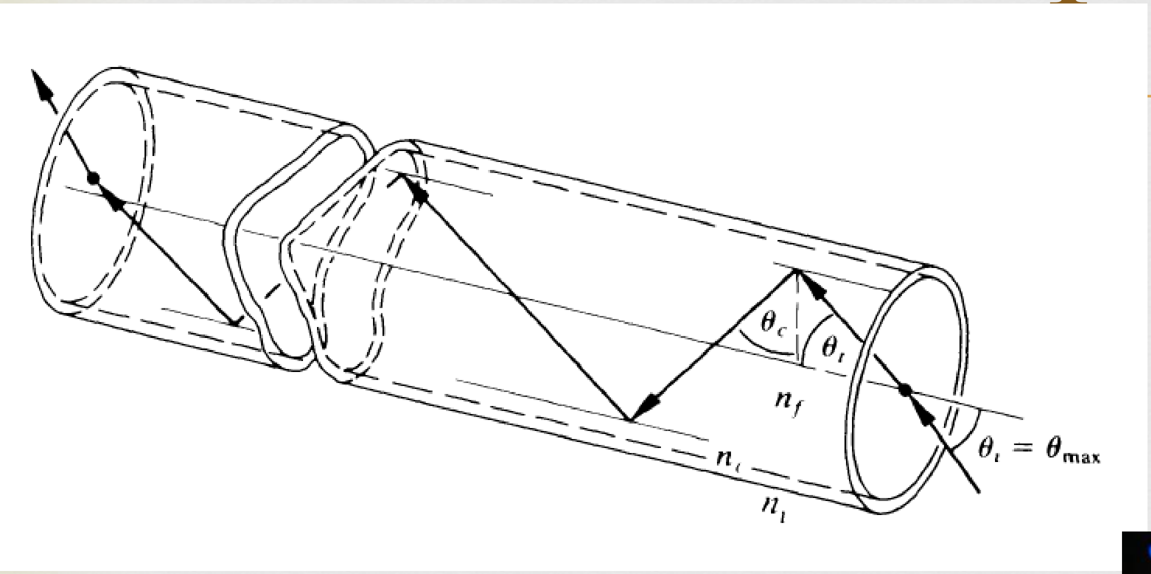


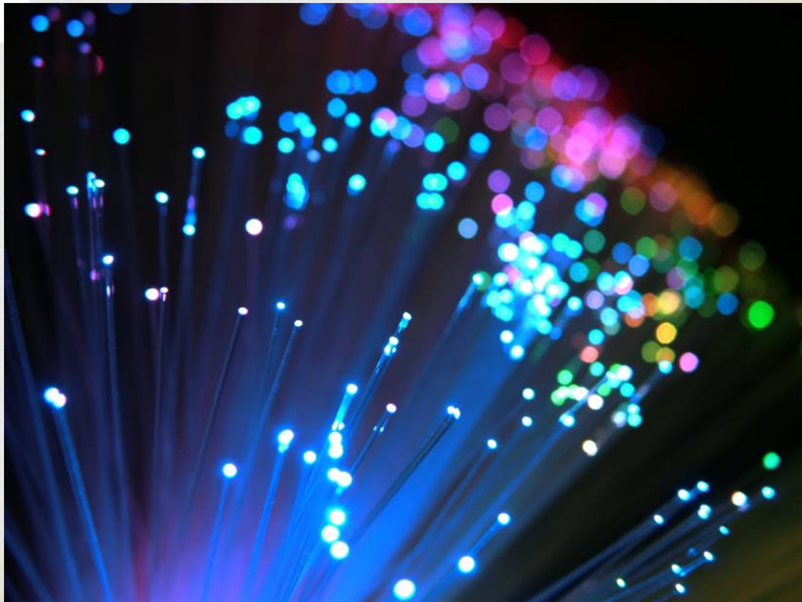
Figure 5.63 The Dove prism.





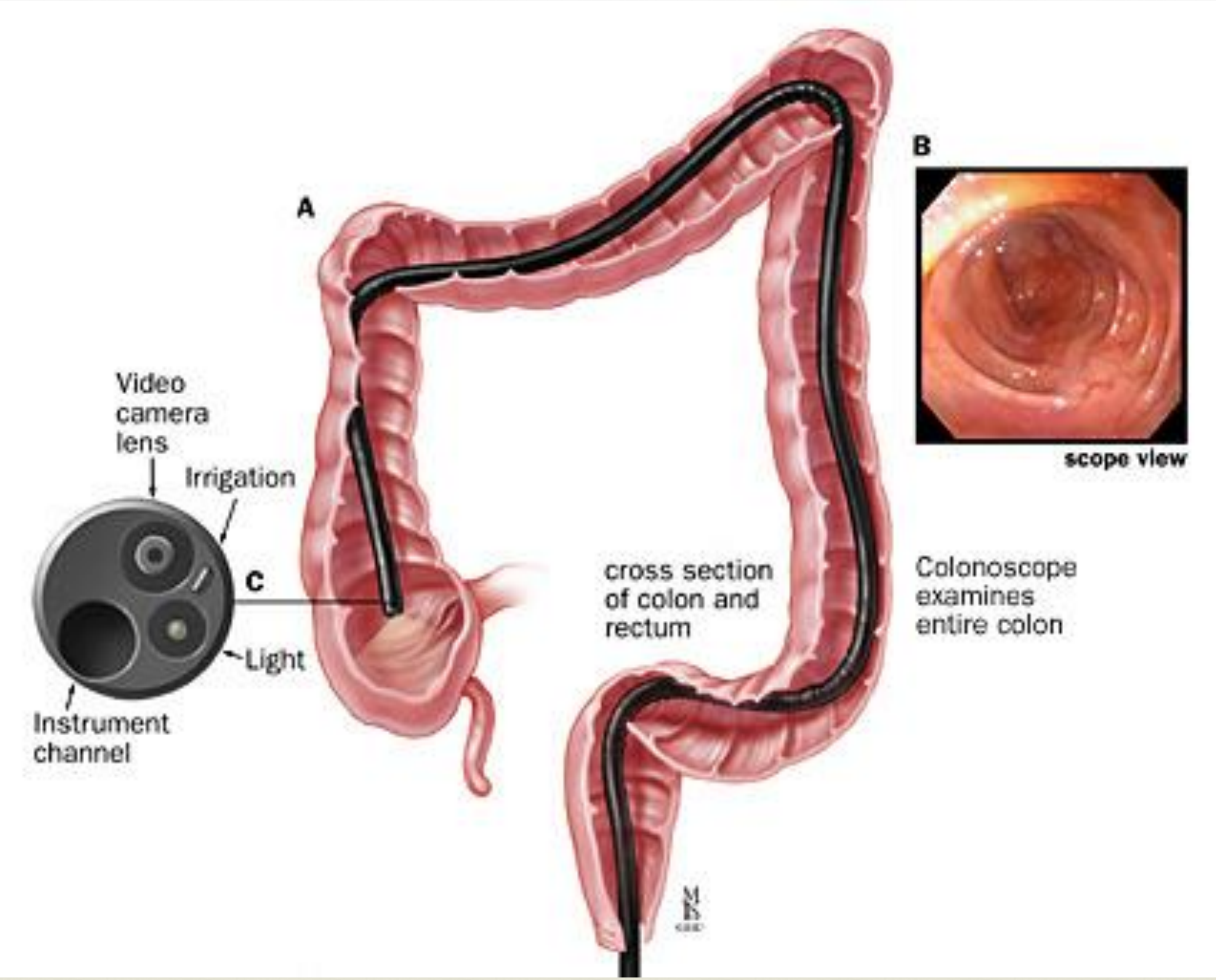
Fiber Optics





$$NA = n_i \sin \theta_{max}$$

Colonoscope



Fiberoptical Communication

Charles K Kao
Nobel Prize in Physics in 2009

"for groundbreaking achievements concerning the transmission of light in fibers for optical communication"

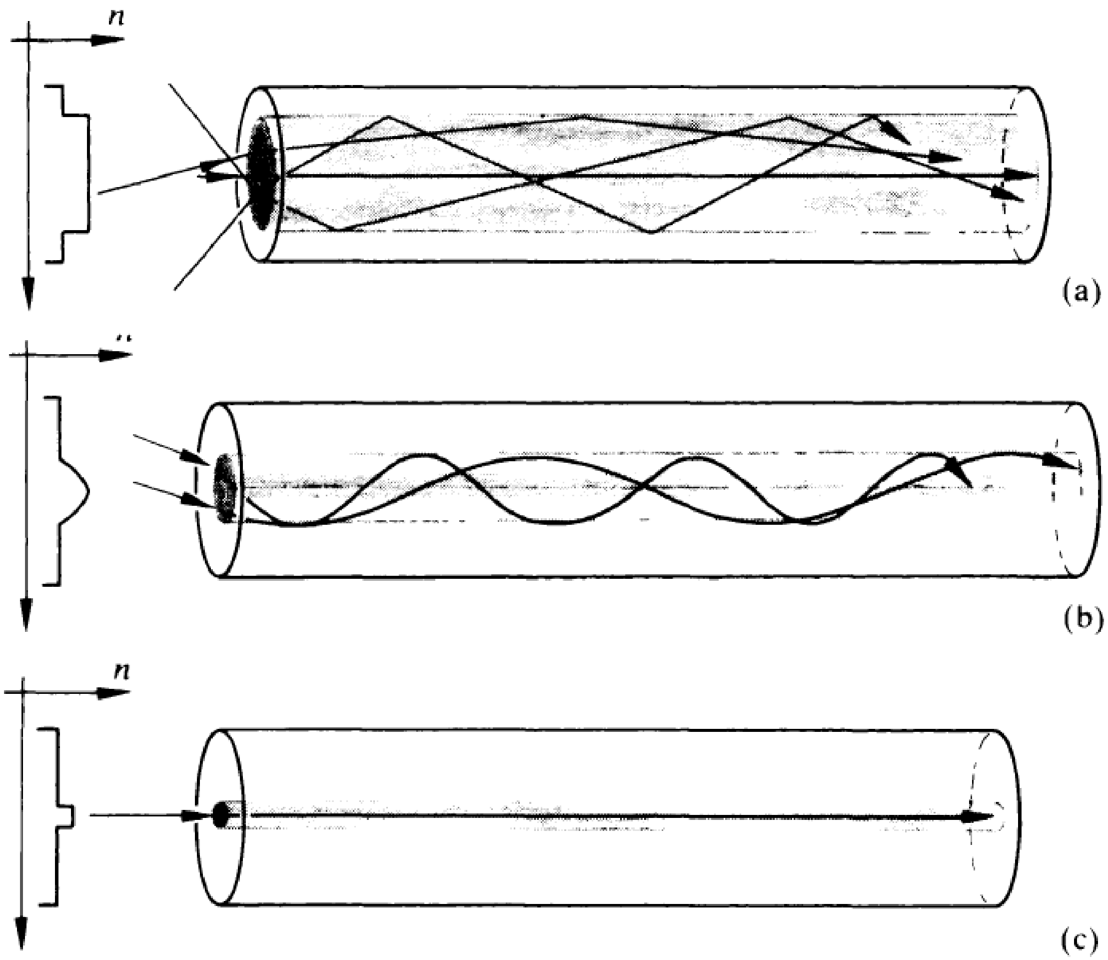
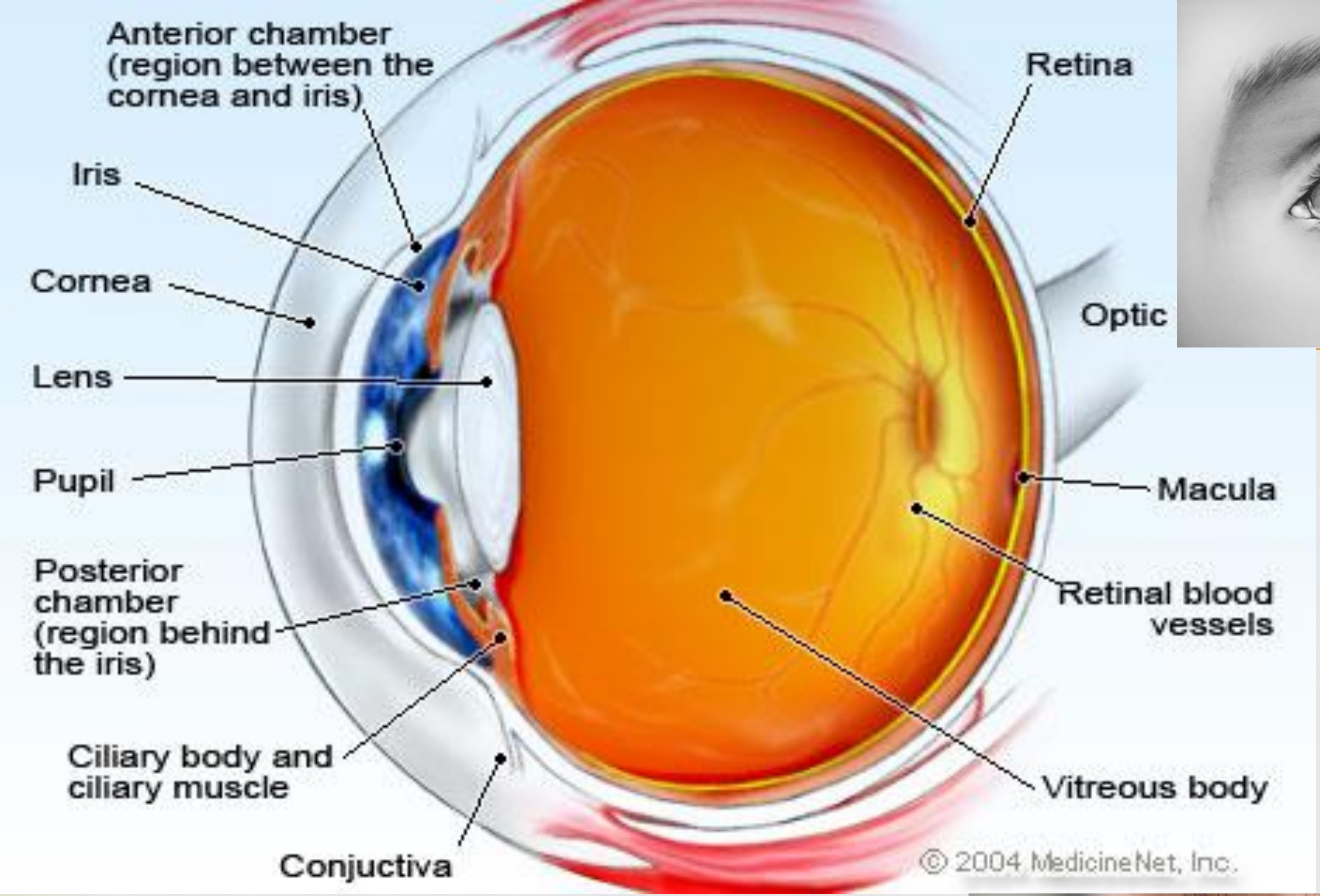
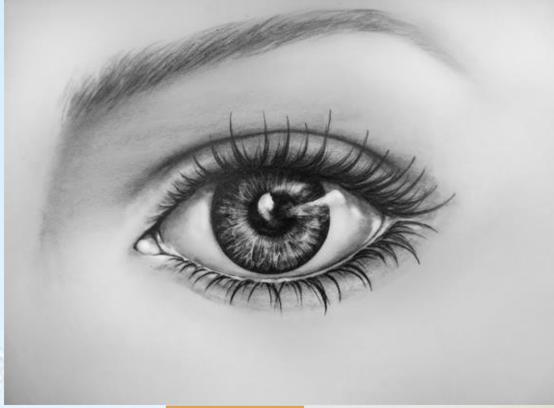


Figure 5.72 The three major fiberoptic configurations and their index profiles. (*a*) Multimode step-index fiber. (*b*) Multimode graded-index fiber. (*c*) Single-mode step-index fiber.

5.7 Optical Systems

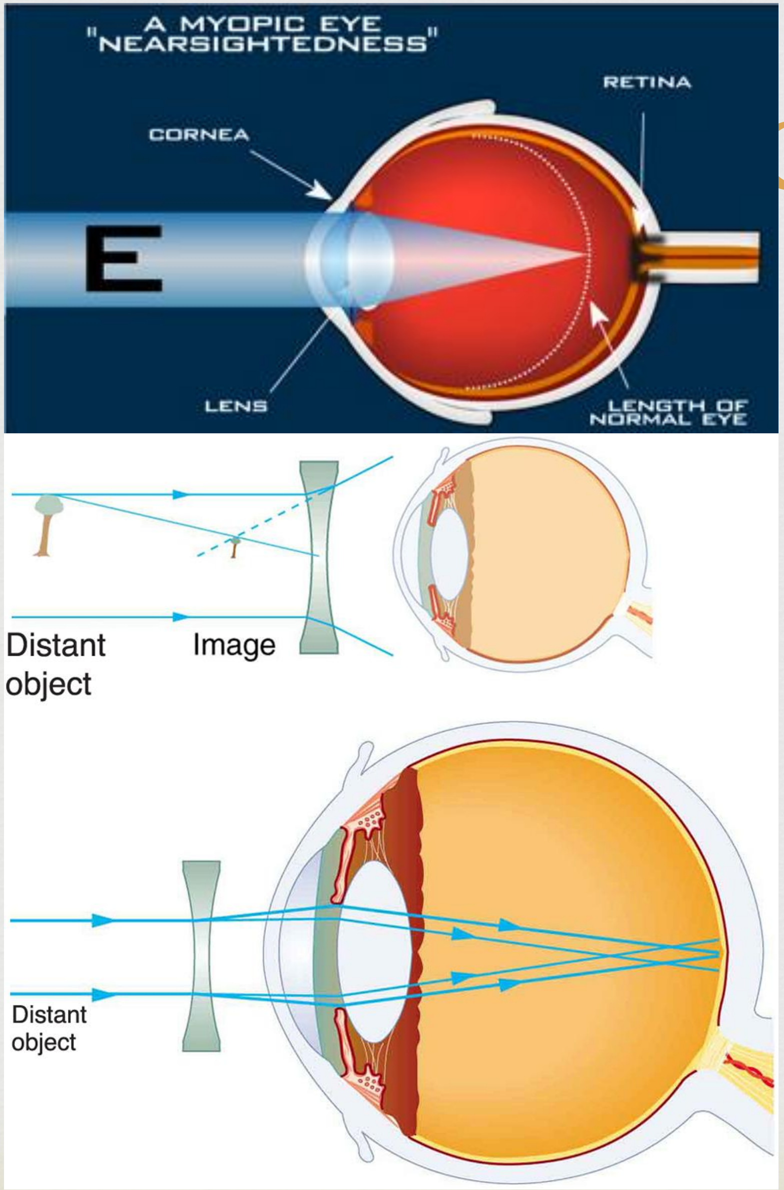
- Eyes
- Eyeglasses
- Microscope
- Camera
- Telescope

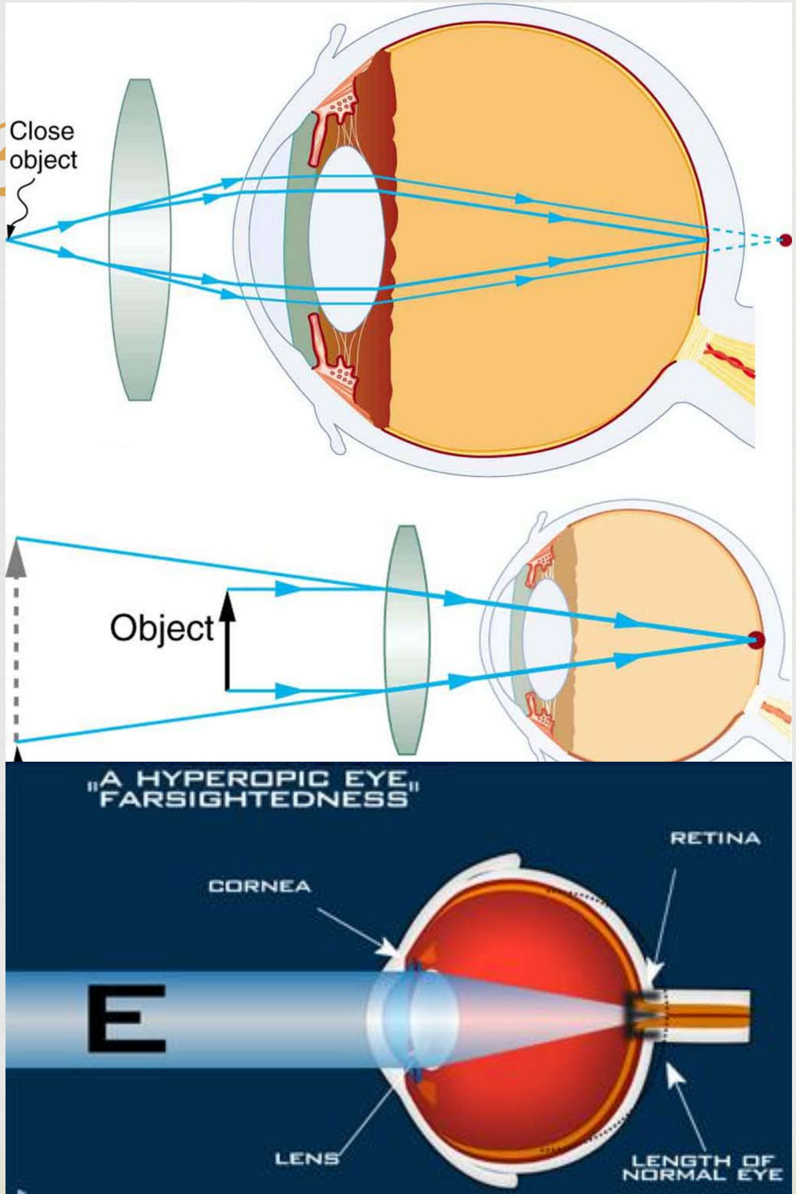

Anterior chamber
(region between the
cornea and iris)
Iris
Cornea
Lens
Pupil
Posterior
chamber
(region behind
the iris)
Ciliary body and
ciliary muscle
Conjuctiva
Retina
Optic
Macula
Retinal blood
vessels
Vitreous body
© 2004 MedicineNet, Inc.



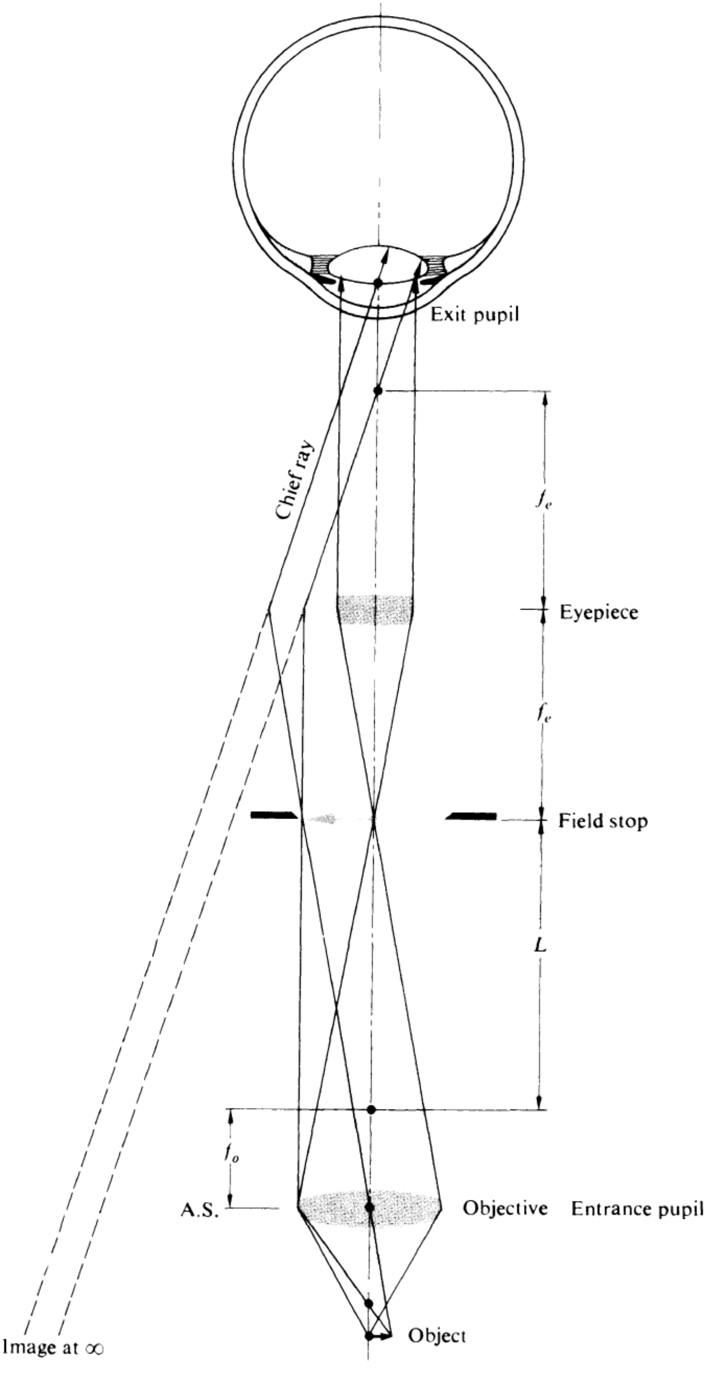
Eye

Eyeclasses


"A MYOPIC EYE
"NEARSIGHTEDNESS"
RETINA
CORNEA
E
LENS
LENGTH OF
NORMAL EYE
Distant
object
Image
Distant
object


Close
object
Object
"A HYPEROPIC EYE"
"FARSIGHTEDNESS"
RETINA
CORNEA
E
LENS
LENGTH OF
NORMAL EYE

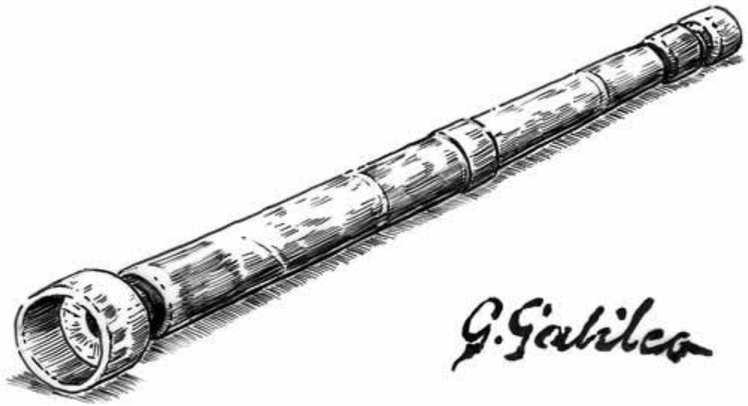
Microscope

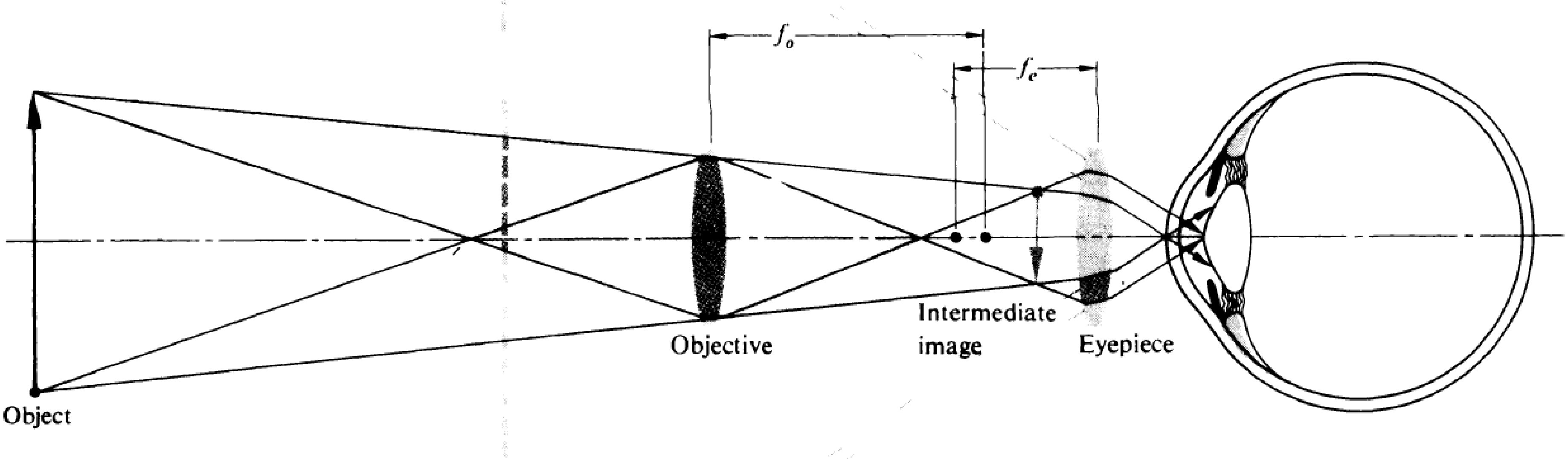

Exit pupil
Chief ray
f_e
Eyepiece
f_e
Field stop
L
f_o
A.S.
Objective
Entrance pupil
Image at ∞
Object


Motic BA310
BA310

Camera

Telescope


G. Galileo


f_o
f_e
Object
Objective
Intermediate image
Eyepiece

Hubble Telescope