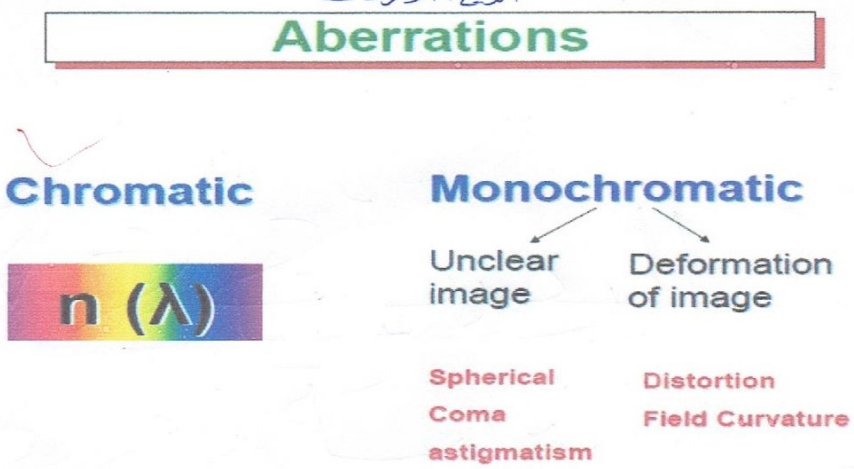
ABERRATIONS

Aberrations: In an ideal system, all rays of light from a point in the object plane would converge to the same point in the image plane, forming a clear image ,the influences which cause different rays to converge to different points are called aberrations.

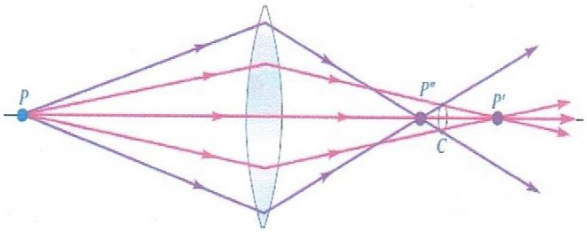
Aberrations can be classified as **chromatic aberrations,** which involve wavelength-dependent imaging behavior, or **monochromatic aberrations,** which occur even with monochromatic (single-wavelength)light. Lens aberrations are not caused by faulty construction of the lens, such as irregularities in its surfaces, but are inevitable consequences of the laws of refraction at spherical surface.

الزيغ، الانحرافات



spherical aberrations: *Spherical aberration* is the failure of rays from a point object on the optic axis to converge to a point image

spherical aberration of a lens: for lenses made with spherical surfaces,rays which are parallel to the optic axis but at different distances from the optic axis fail to converge to the same point.spherical aberration can be minimized by bending the lens into its best form.for multiple lenses,spherical aberrations can be canceled by overcorrecting some elements.the use of symmetric doublets greatly reduces spherical aberration.

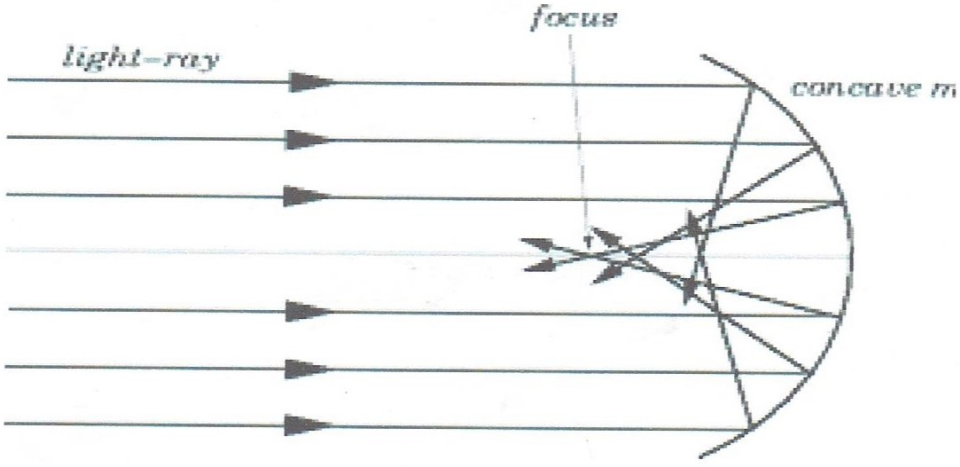


Spherical aberration for a lens. The circle of least confusion is shown by *C*.

b- spherical aberration of mirrors:

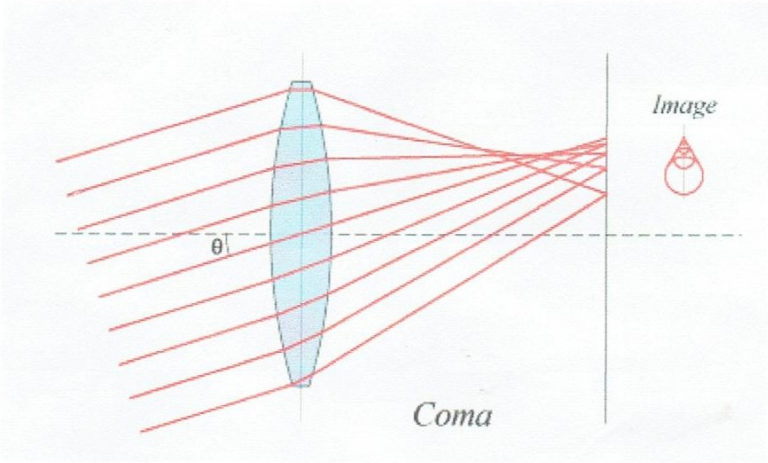
in our study of concave mirrors, we are going to assume that all light rays which strike a mirror parallel to its principal axis, are brought to focus at

the same point F .the lack of this perfect focusing of a spherical mirror is called spherical aberration of the mirror.



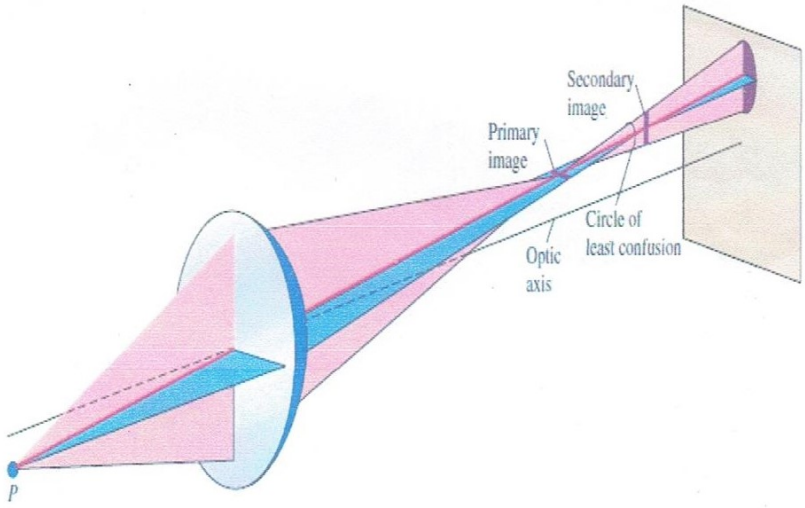
For mirrors, spherical aberration can be avoided by using a *parabolic* mirror. A parabolic mirror focuses parallel rays to a point even if they are not paraxial.

coma aberration :coma is an aberration which causes rays from an off-axis point of light in the object plane to create a trailing "comet-like "blur directed away from the optic axis . or it is an off-axis effect which appears when a bundle of incident rays all make the same angle with respect to the optical axis (source at infinity)a lens with considerable coma may produce a sharp image in the center of the field, but become increasingly blurred toward the edges.
coma, for a single lens can be corrected by bending the lens. for complete correction can be achieved by using a combination of lenses symmetric about a central stop



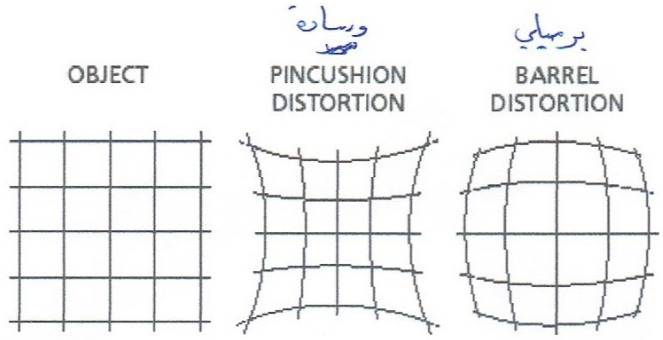
Astigmatism aberration: An ideal optical instrument produces an image of a point source, which is also a point. If the image is not a point, then it is astigmatism.

Astigmatism is the imaging of a point off the axis as two perpendicular lines indifferent planes. In this aberration the rays from a point object converge at a certain distance from the lens to a line called the primary image, which is perpendicular to the plane defined by the optic axis and the object point. At a somewhat different distance from the lens, they converge to a second line, called the secondary image, which is parallel to this plane. The circle of least confusion (greatest convergence) appears between these two positions. The location of the circle of least confusion depends on the object point's transverse distance from the axis as well as its longitudinal distance from the lens.



Distortion:

The image of a straight line that does not pass through the optic axis may be curved. As a result, the image of a square with the axis through its center may resemble a barrel (sides bent outward) or a pincushion (sides bent inward).This effect, called *distortion,* is not related to lack of sharpness of the image but results from a change in lateral magnification with distance from the axis. there are two types of distortion: pincushion distortion, and barrel distortion.



curvature of field:

In most optical systems ,the final image must be formed on aplane or flat surface. unfortunately, most optical systems tend to form that image on a curved surface.