Introduction to Computer Vision

CSE 327 Spring 2012

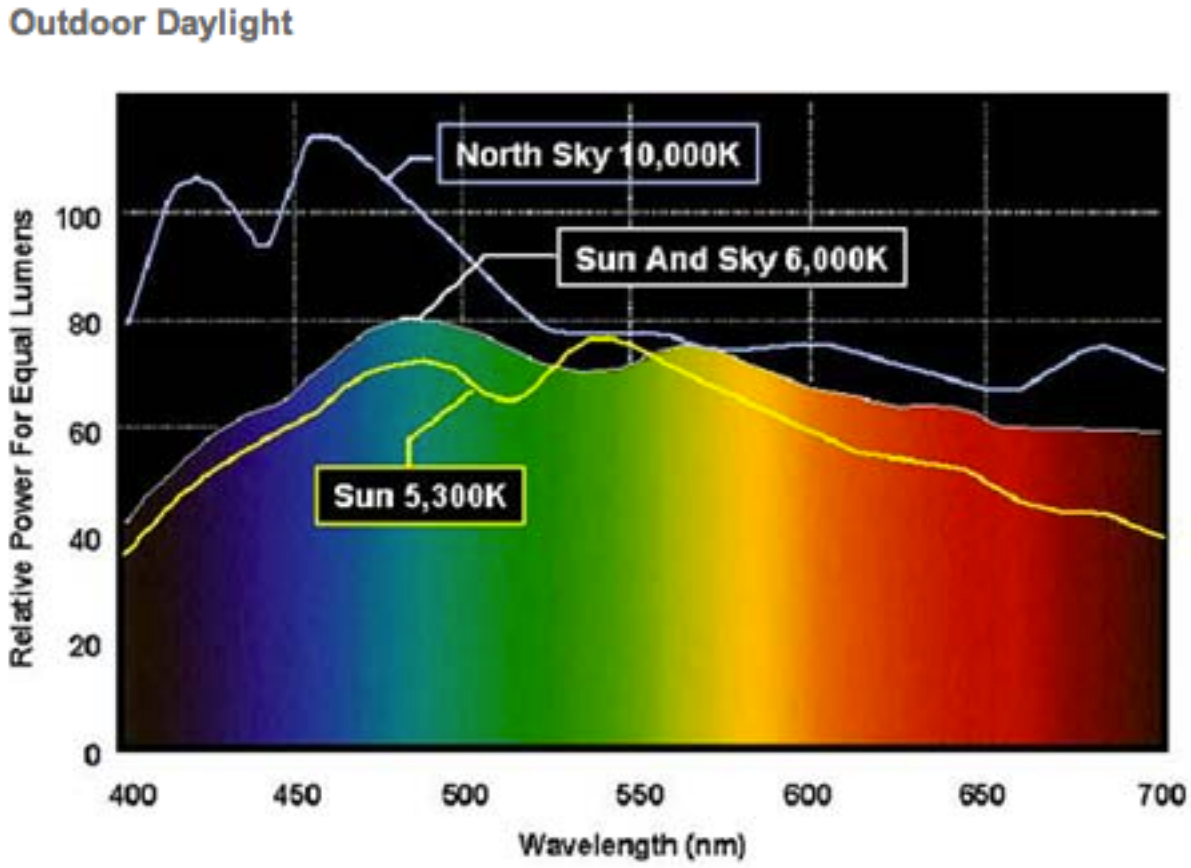
Lecture 1

Prof. Alex Berg

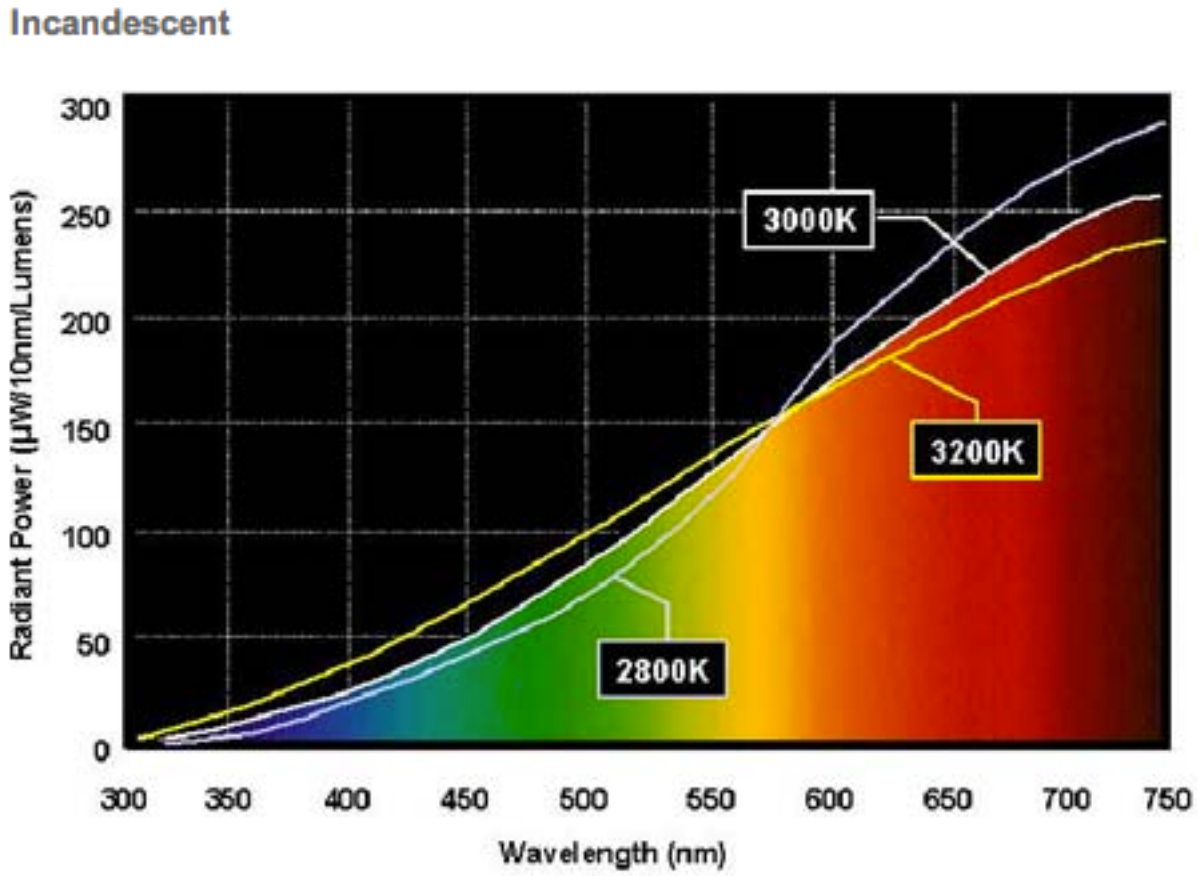
Why Vision? Light!

- What is it?
- What does it do?
- How do we measure it?

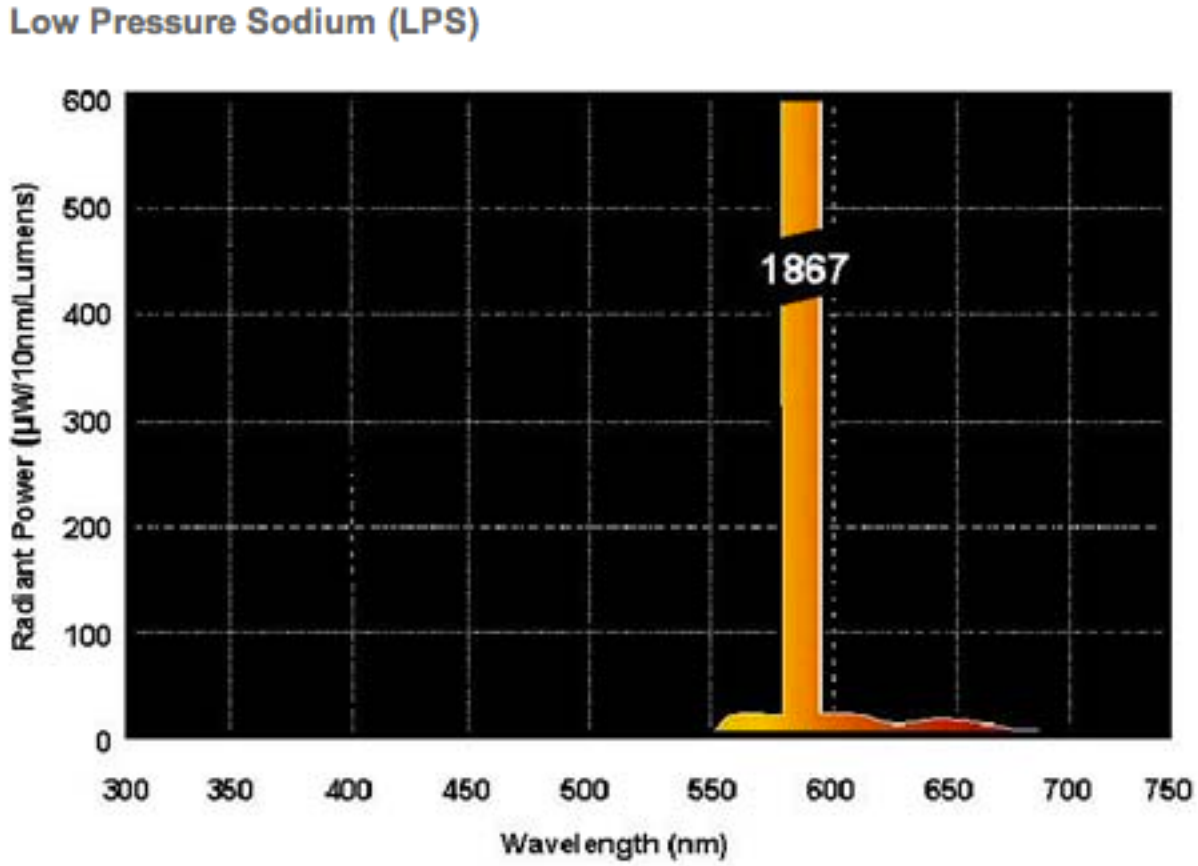
Spectral Energy Distribution



Spectral Energy Distribution



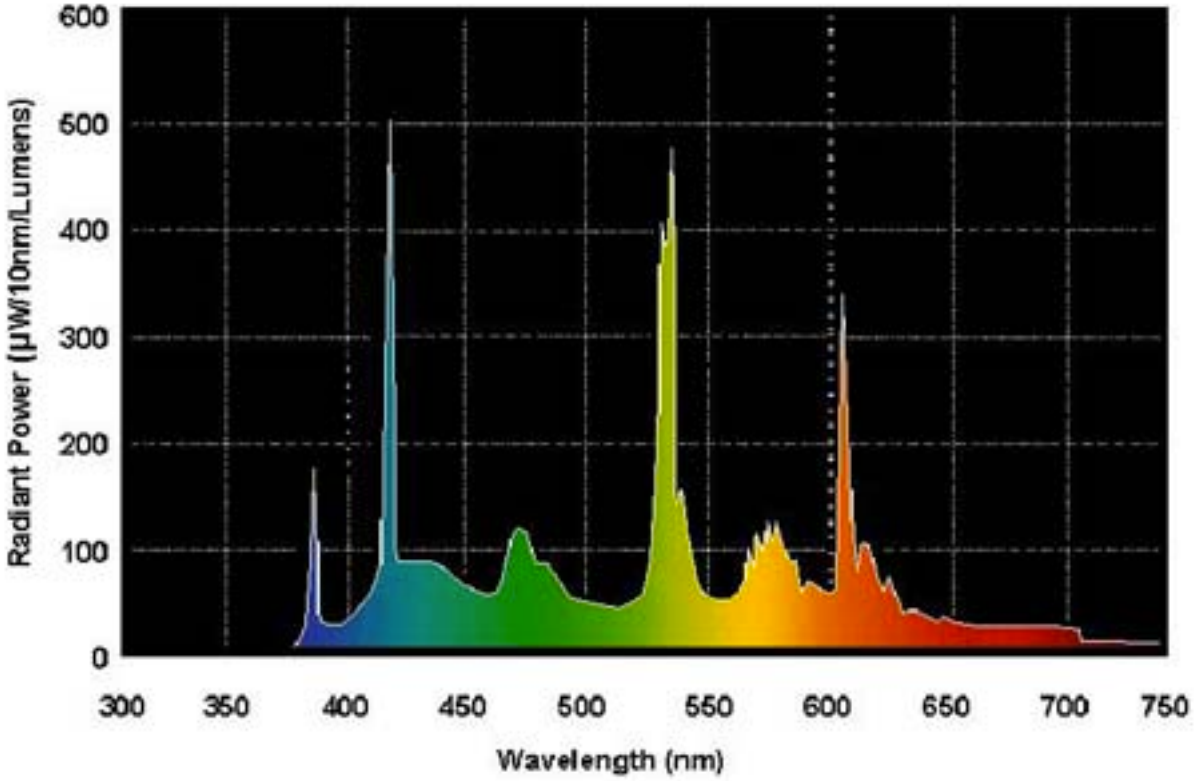
Spectral Energy Distribution



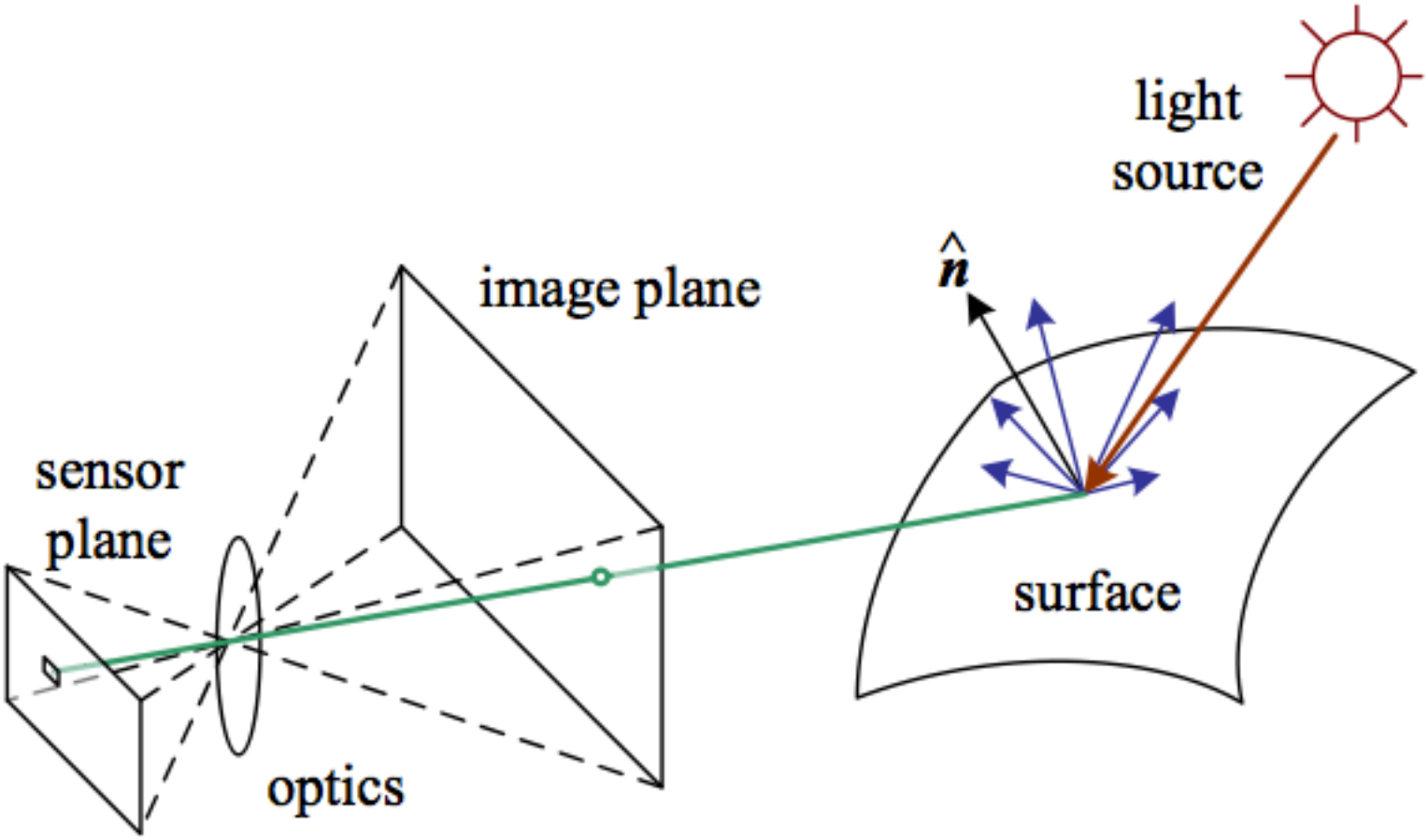
Spectral Energy Distribution

Spectral Power Distribution Curves
Tri-Phosphor Fluorescent Colors

SP65



Light (transport) from source to measurement device



From Computer Vision by R. Szeliski

“Global” Illumination – multiple bounces

“Cornell” box

"What has nature got to do with it? No one knows what's in nature and what isn't! The world sees nature through the eyes of the artist. Why, for centuries it saw horses jumping a fence with all their legs extended, and by Heavan, sir, they were extended. It saw shadows black until Monet discovered they were colored, and by Heaven, sir, they were black. ...”

From Of Human Bondage by Summerset Maugham

Sunny but in shadow

Greenish

http://www.flickr.com/photos/bnittoli/209757259/

Subsurface scattering

Photon Mapping (1998)

BRDF Model (2001)

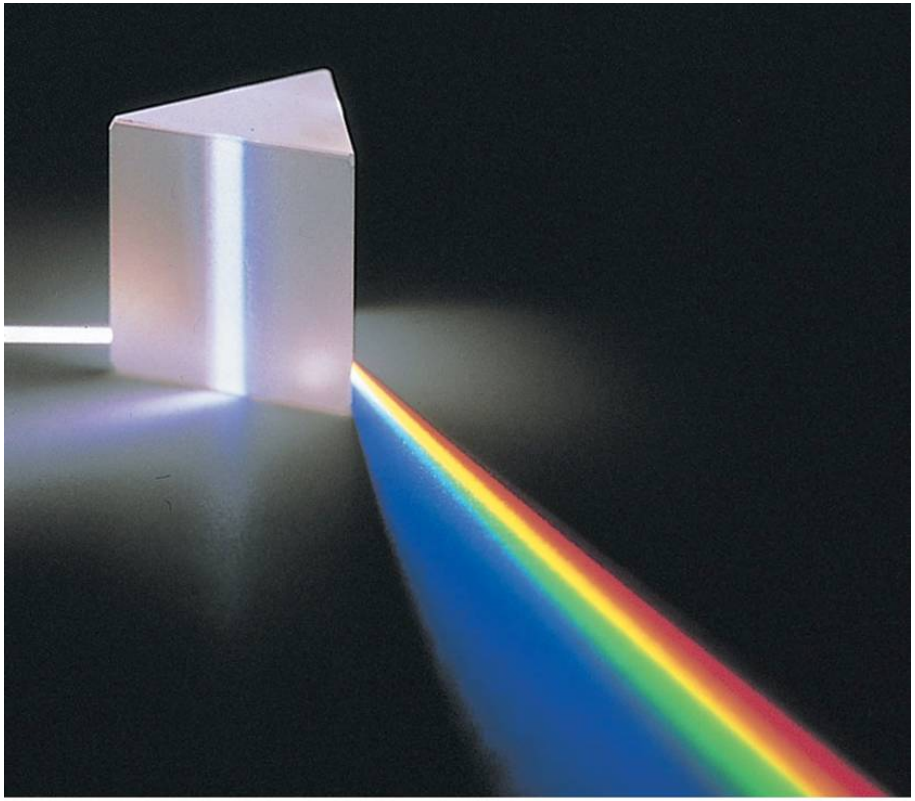
BSSRDF Model (2001)

BRDF rendering

BSSRDF rendering

Henrik Wann Jensen http://graphics.ucsd.edu/~henrik/images/subsurf.html

Dispersive refraction



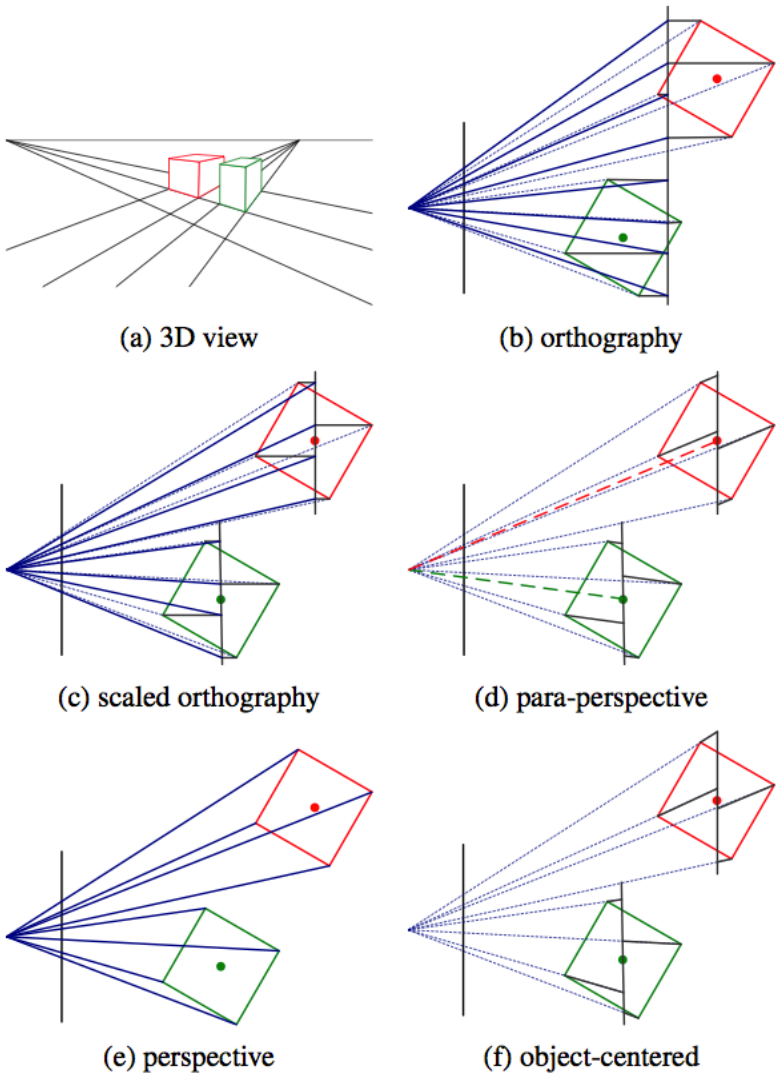
"Reflection is boring…"

Subsurface scattering and dispersive refraction

Taking pictures, 3D(+?) light -> 2D image

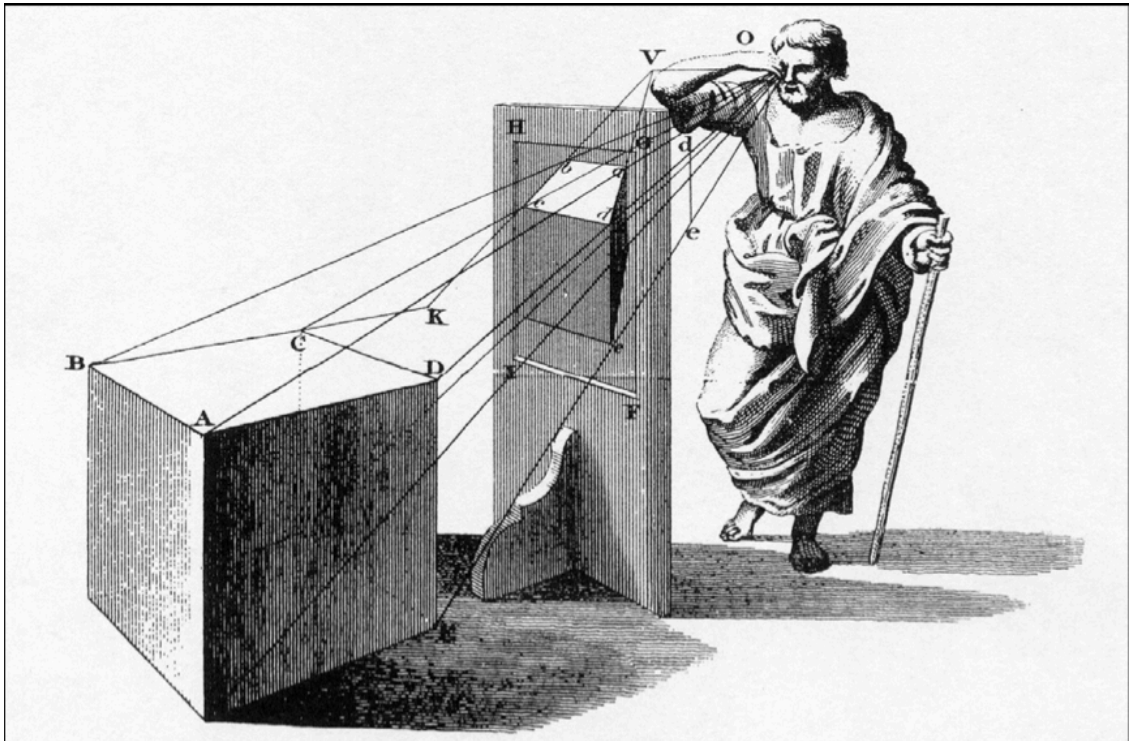
http://photojojo.com/store/awesomeness/iphone-telephoto-lens/

3D -> 2D



Projections

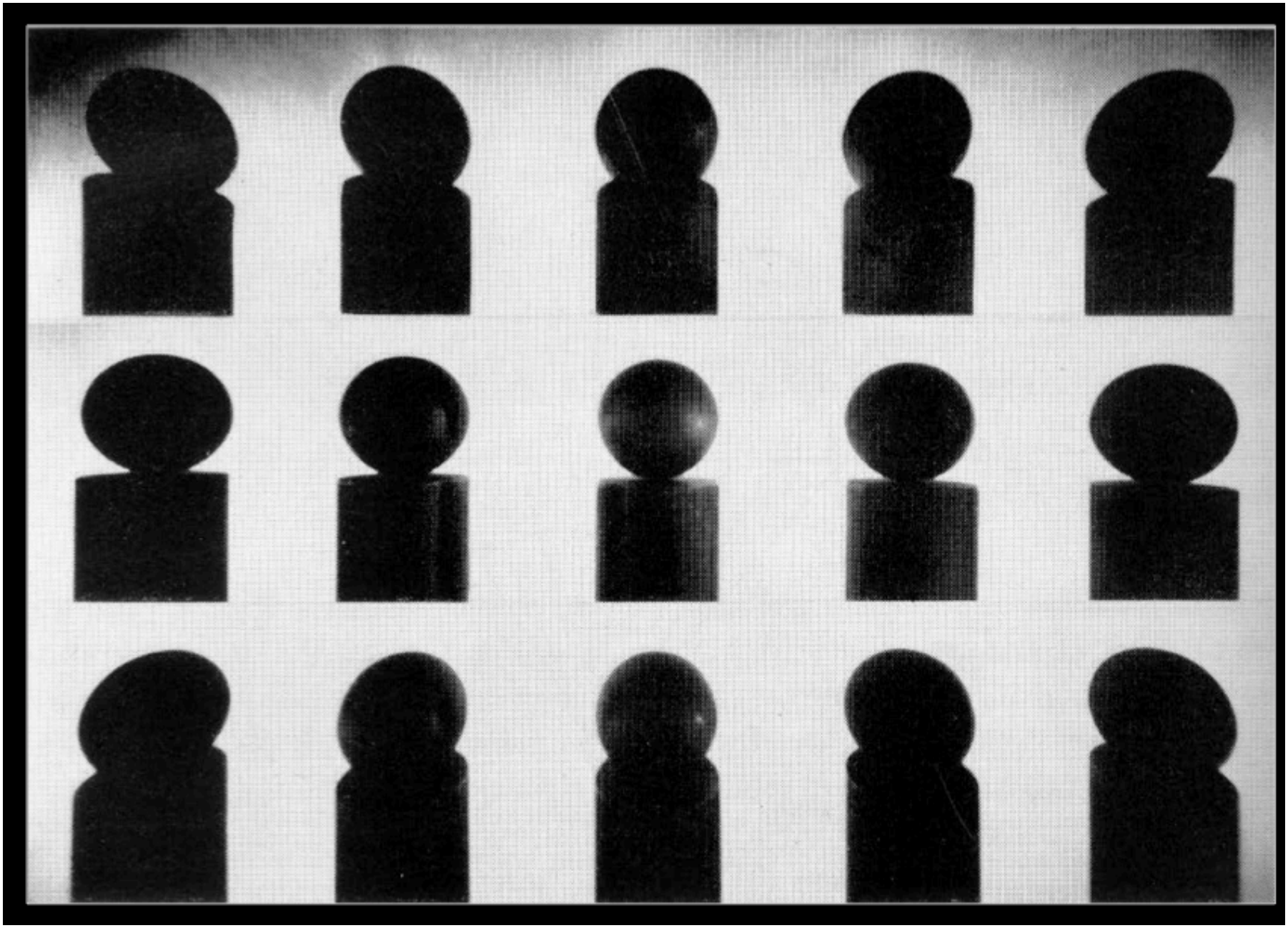
Perspective



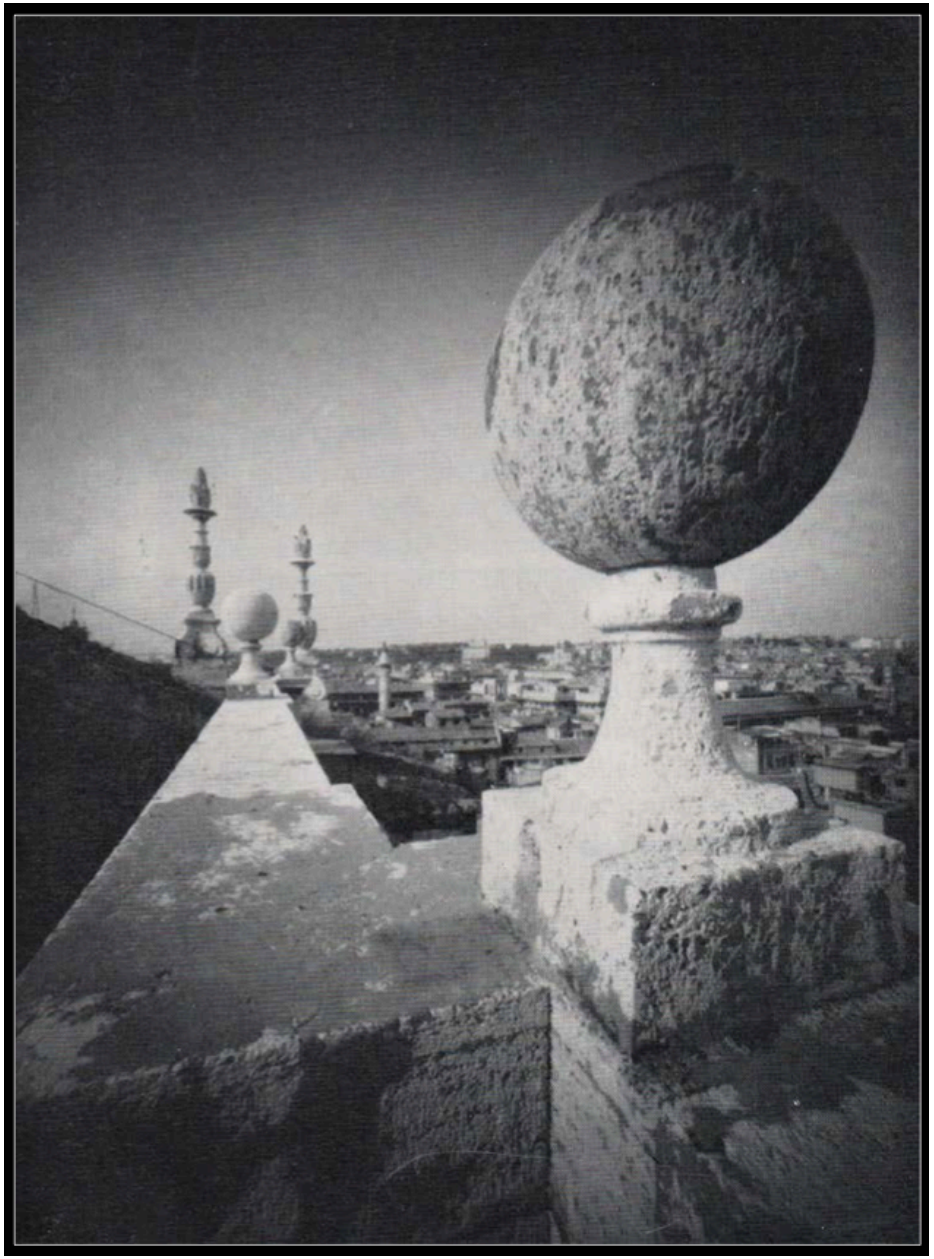
7.1 The principle of linear perspective

The pyramid of sight defined by the object *ABCDE* and the centre of rotation *O* of the eye of the spectator, who keeps his other eye shut, is intersected by the surface *FGHI*, thus forming on it the projection *abcde* in linear perspective. If the surface *FGHI* is a transparent Leonardo window, the eye sees this perspective covering the actual object exactly. (The whole figure here is of course shown in perspective including the picture *abcde*, which is seen foreshortened, and from the side opposite to the eye *O*. The spectator is depicted holding his hand to his eye presumably because in earlier illustrations of this period strings were used to materialize the lines constituting the pyramid of sight.) (From Brook Taylor (1811), *New Principles of Linear Perspective*.)

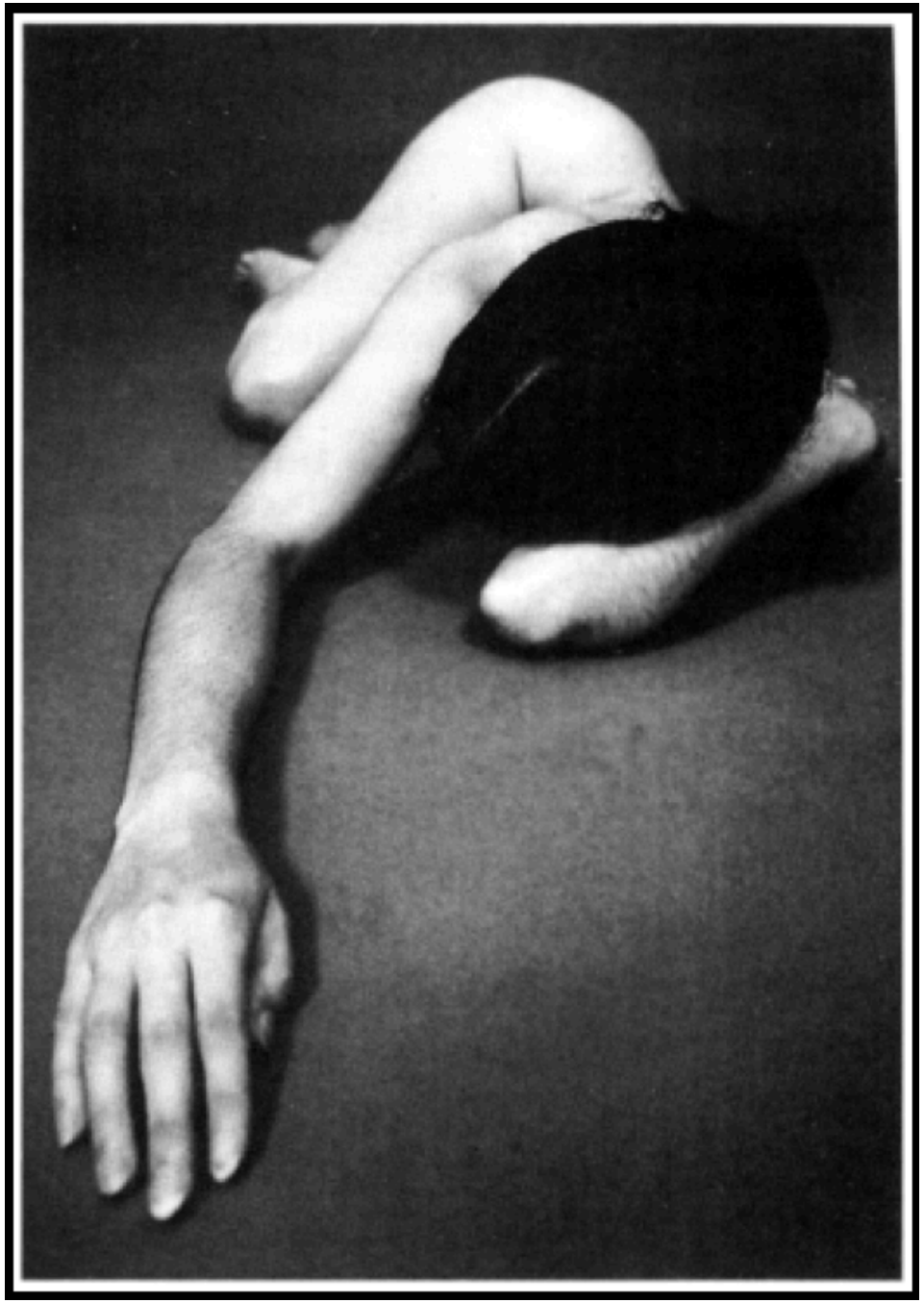
http://bankslab.berkeley.edu/



http://bankslab.berkeley.edu/



http://bankslab.berkeley.edu/



http://bankslab.berkeley.edu/

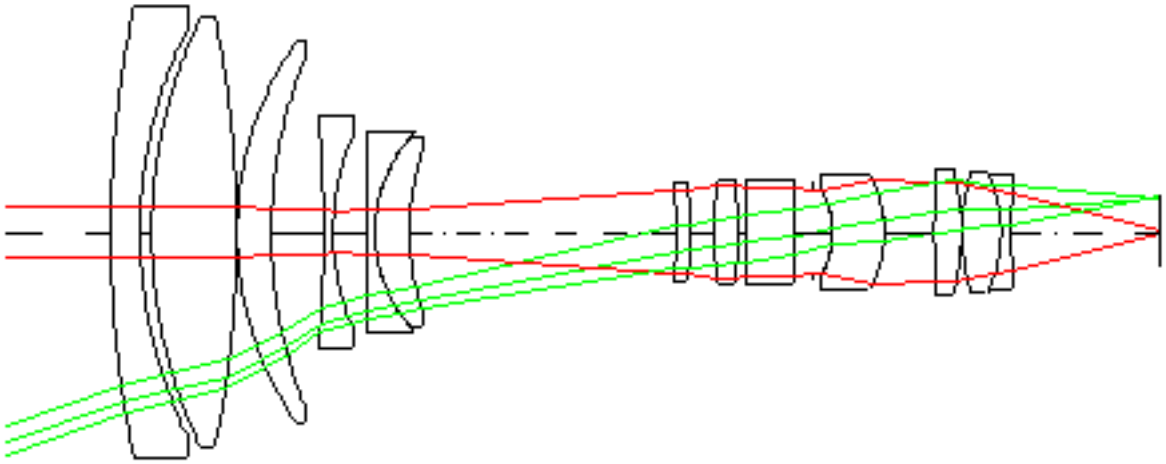
http://bankslab.berkeley.edu/

Perspective

http://www.petapixel.com/2011/11/07/a-striking-look-at-how-focal-length-affect-head-shots/

http://stepheneastwood.com/tutorials/lensdistortion/strippage.htm

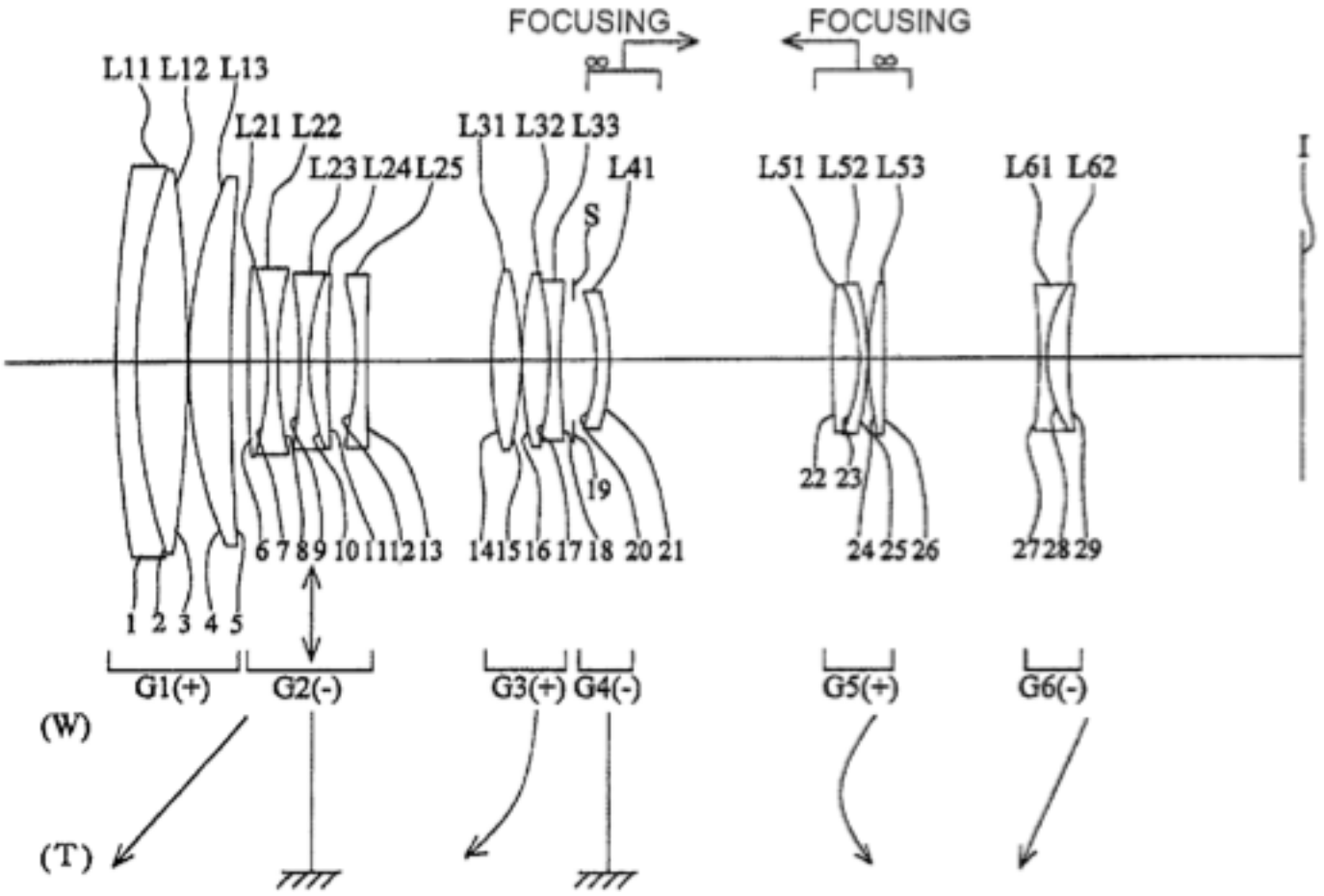
3D -> 2D for real



Check out:
http://www.opticalres.com/optics_for_kids/kidoptx_p2_complex.lenses.html

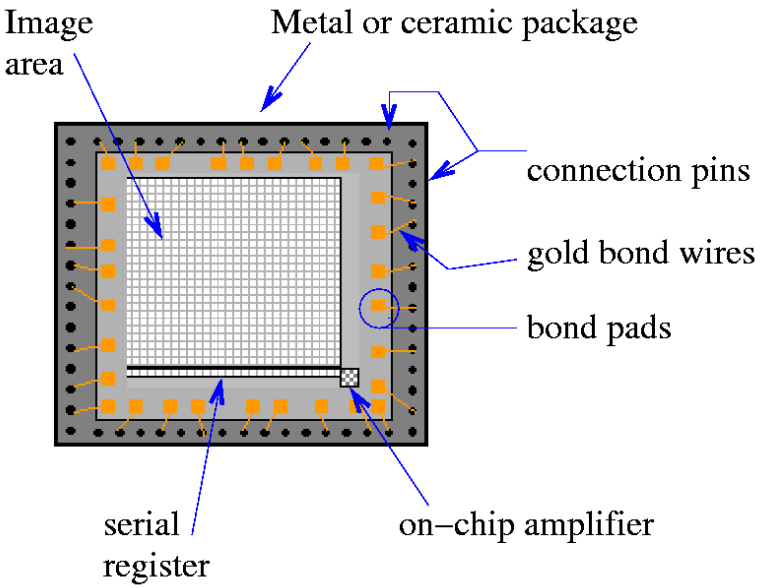
From: http://www.opticalres.com/optics_for_kids/kidoptx_p2.html

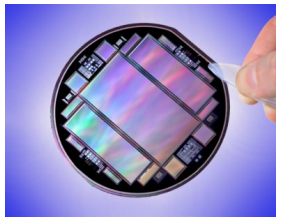
3D -> 2D for real

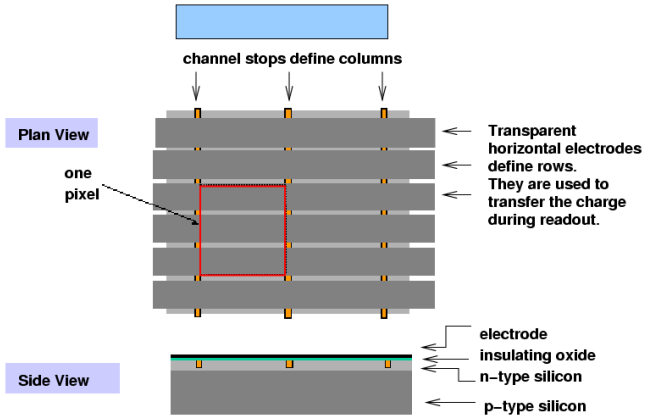


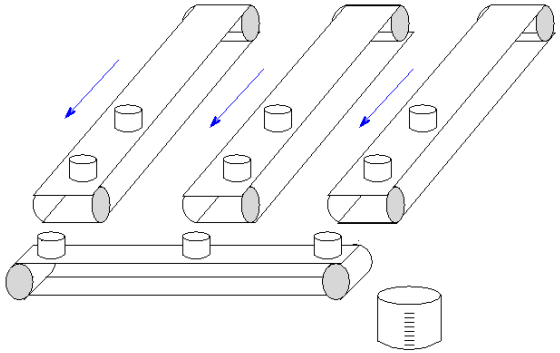
From a Nikon lens patent, via:
http://www.dslrgossip.com/wp-content/uploads/2010/11/Nikon_80-400.png

CCD, CMOS, etc. light -> electricity



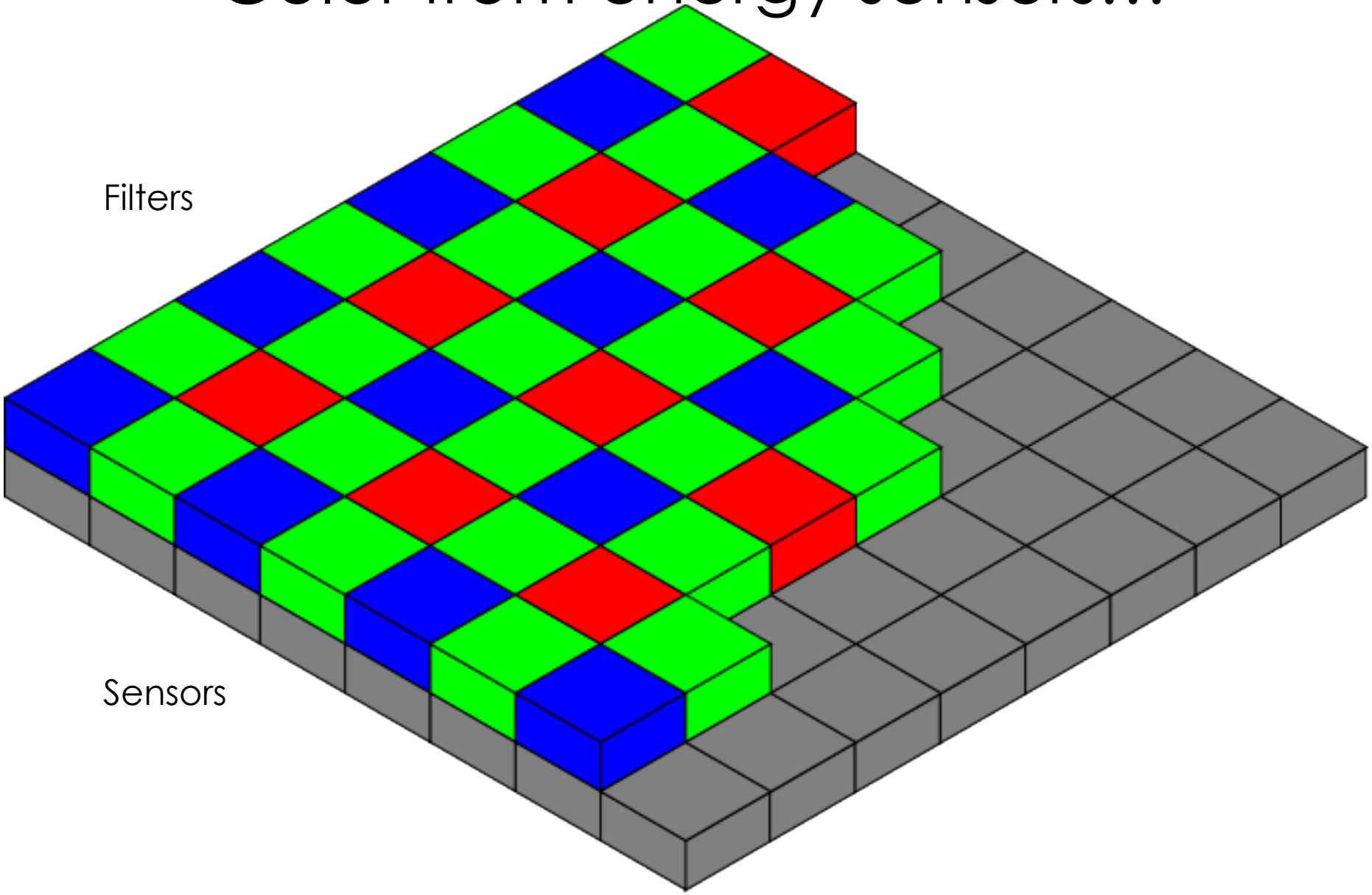






http://spiff.rit.edu/classes/phys445/lectures/ccd1/ccd1.html

Color from energy sensors…



http://en.wikipedia.org/wiki/
File:Bayer_pattern_on_sensor.svg

Color from energy sensors…

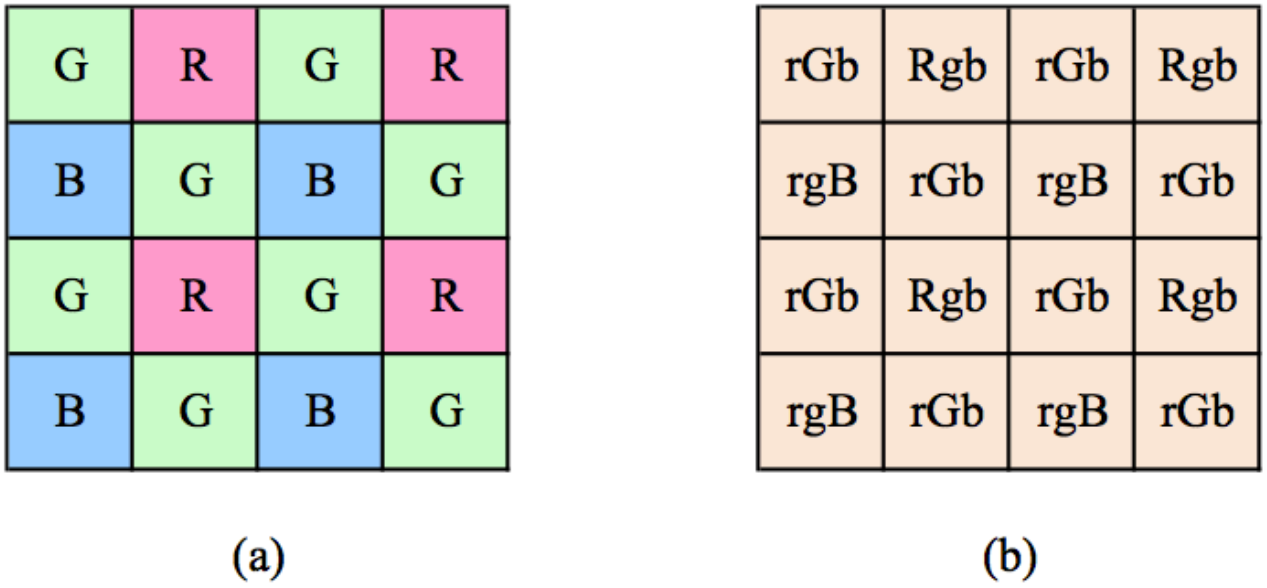
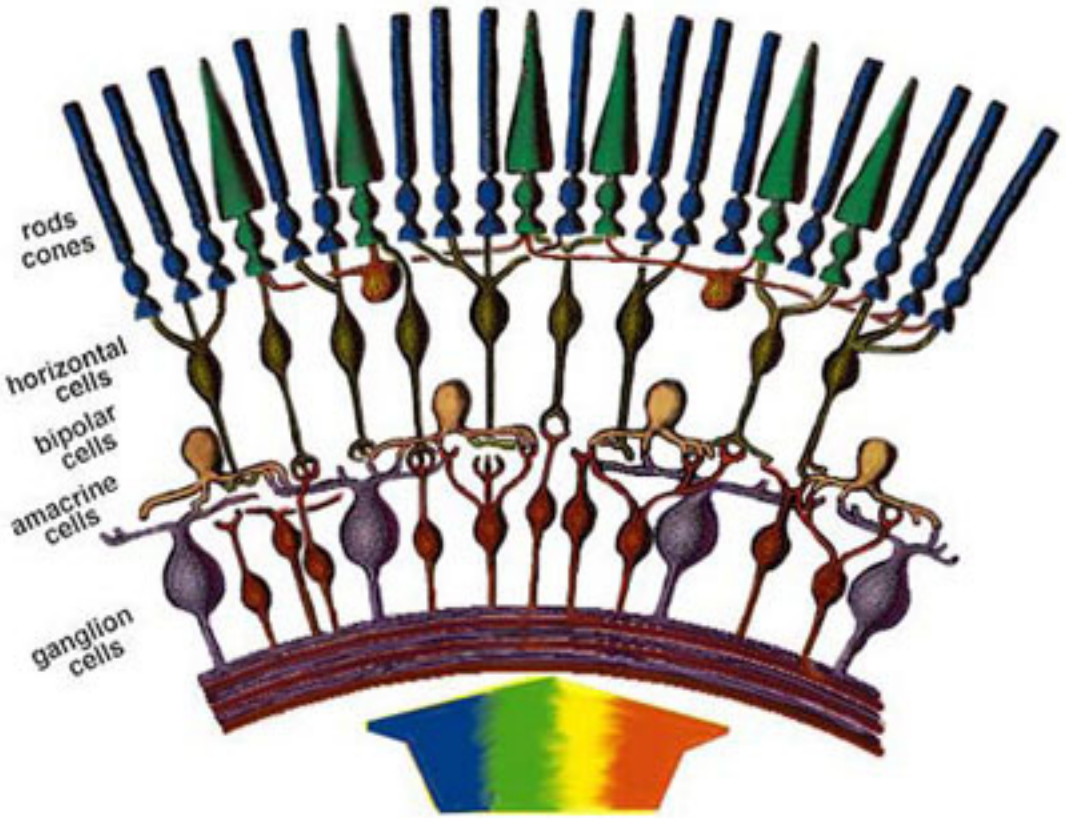


Figure 2.30 Bayer RGB pattern: (a) color filter array layout; (b) interpolated pixel values, with unknown (guessed) values shown as lower case.

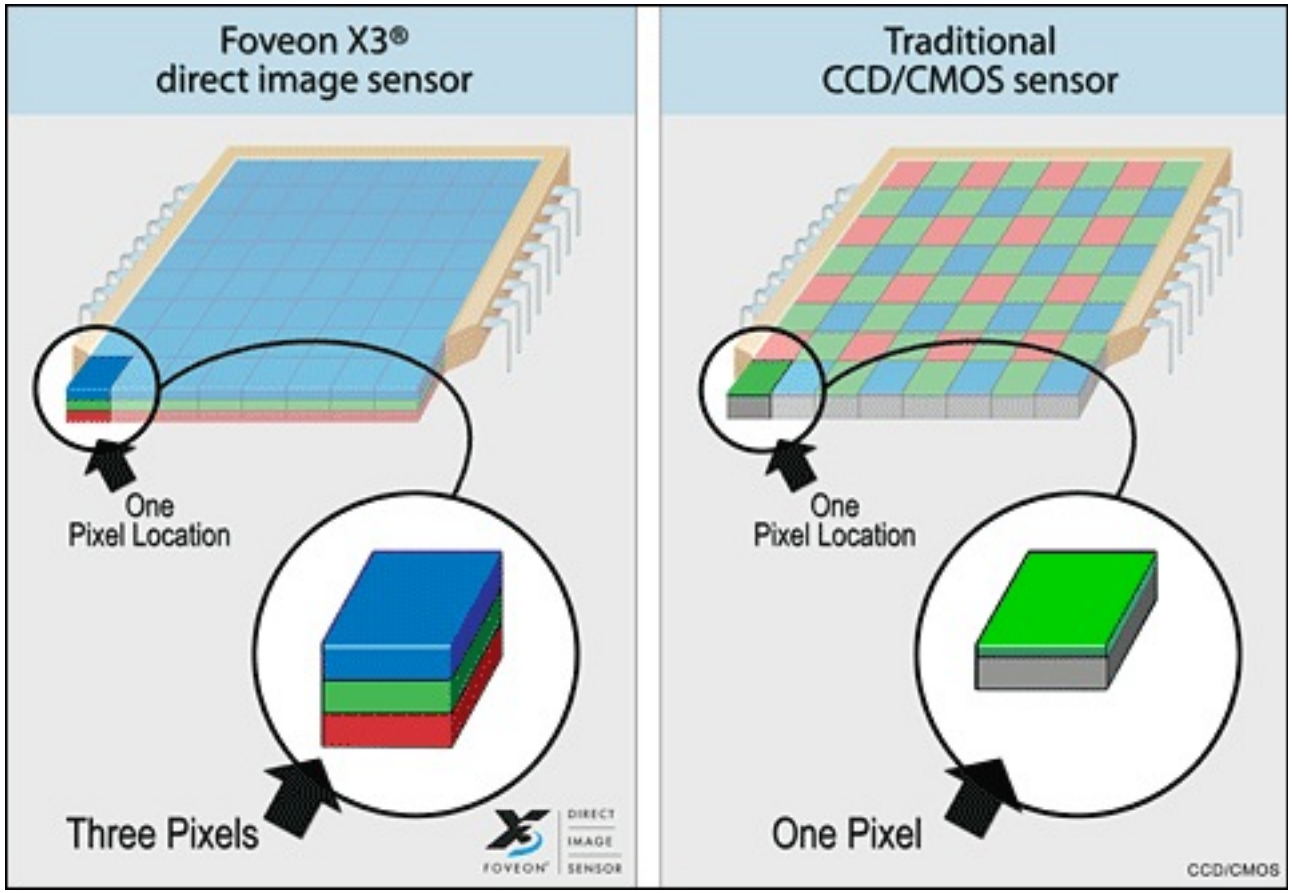
From Computer Vision by R. Szeliski

Human retina – all backwards!



http://www.phys.ufl.edu/~avery/course/3400/vision/retina_schema.jpg

Foveon



http://mydp1.wordpress.com/2007/11/13/whats-the-big-deal-with-foveon-sensors/

For Next Class

- Find a way to access matlab in one of the labs or on your own computer
- Look over a matlab tutorial e.g.
  - http://www.cs.unc.edu/~lazebnik/spring11/matlab.intro.html
- Read chapter 2 in the textbook