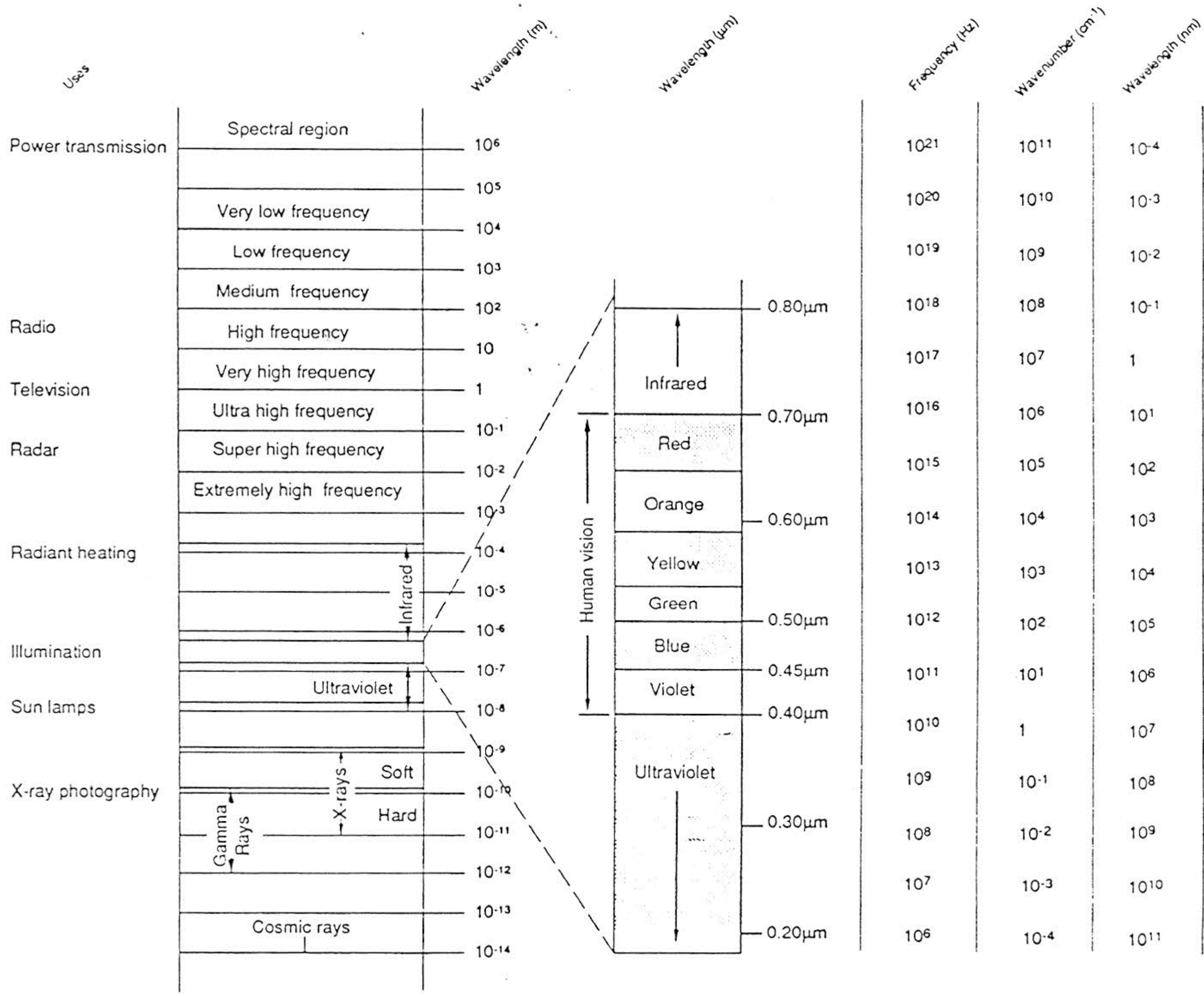
SPECTROPHOTOMETRY



Electromagnetic spectrum, showing the position of the visible region in relation to the other regions. The boundaries between regions are indicated by wavelengths measured in vacuum.

Figure 7.2 Chart of the Electromagnetic Spectrum

LAMBERT'S LAW - when a beam of plane parallel monochromatic light enters an absorbing medium at right angles to plane surfaces of the medium, the rate of decrease in intensity with the length of the light path through the absorbing medium is proportional to the intensity of the beam.

BEER'S LAW - the intensity of energy decreases exponentially with increase in concentration.

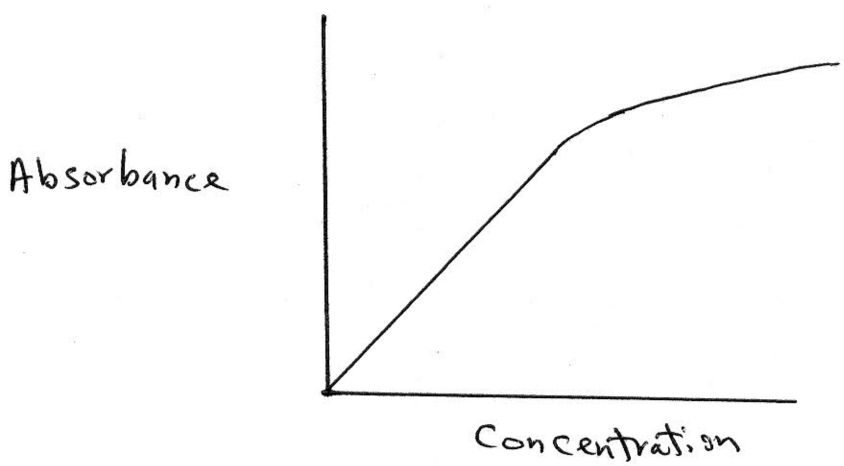
Beer-Lambert Law - $$I = I_0 e^{-ckl}$$

c = concentration

k = constant; (f) medium, wavelength

l = path length

$$\text{Absorbance} = \log \frac{I_0}{I} = kcl$$



To be of value for analytical purposes the color-producing reaction should have the following characteristics:

1. Reagent and the color complex should be stable.
2. The reaction should be stoichiometric.
3. The color development should be rapid and color should resist fading.
4. The reaction should be specific for the element to be determined.
5. The reaction should show no more than minor variation with pH, temperature and other factors.
6. The color complex should be soluble in a solvent which is transparent in the area of spectral absorbance of the complex.
7. The color complex should have a sharp absorbance band.

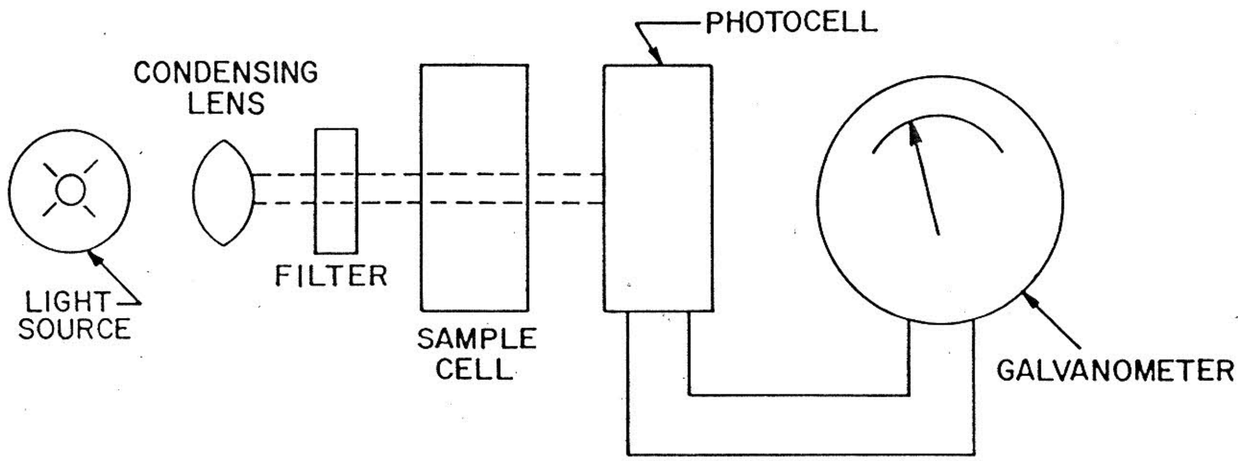
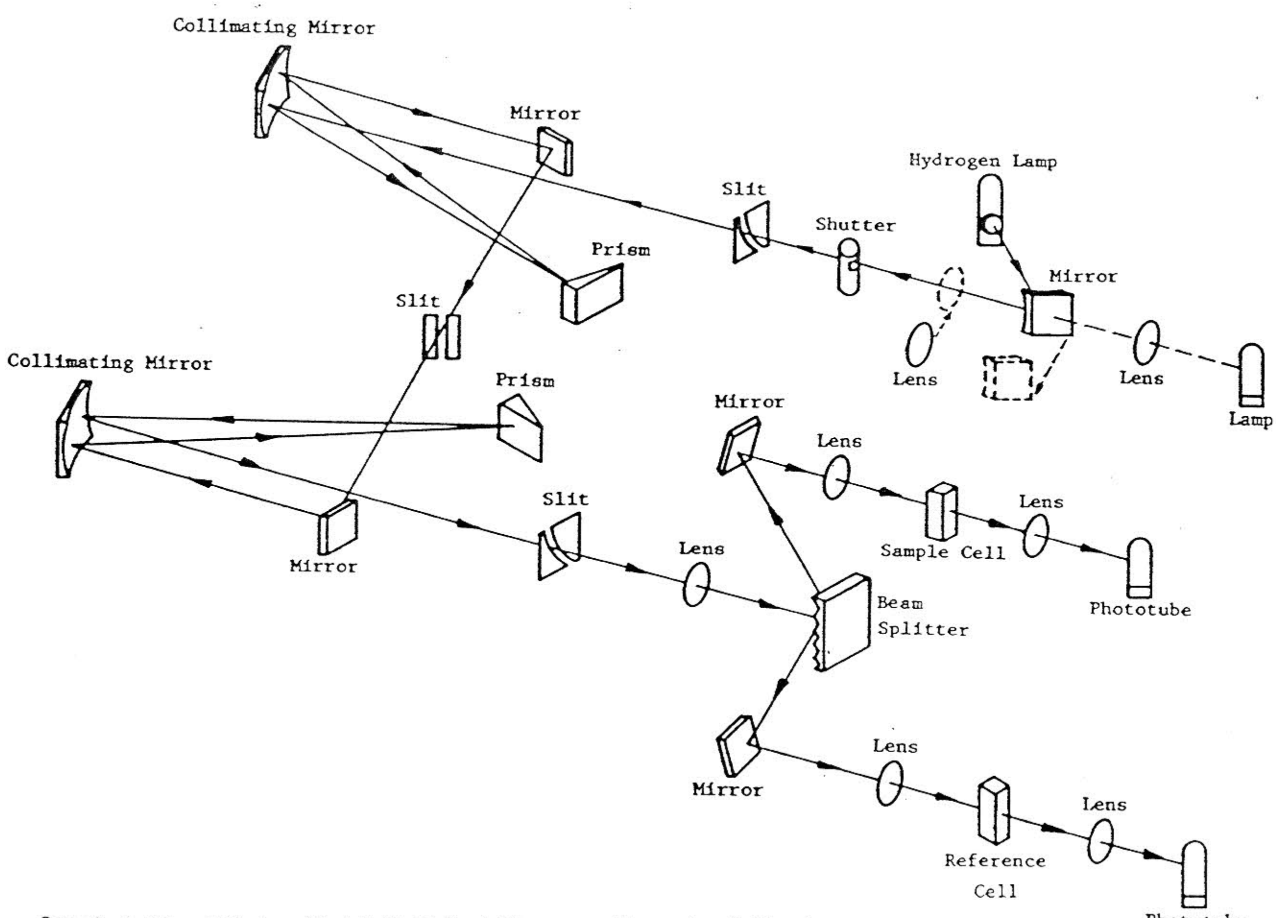
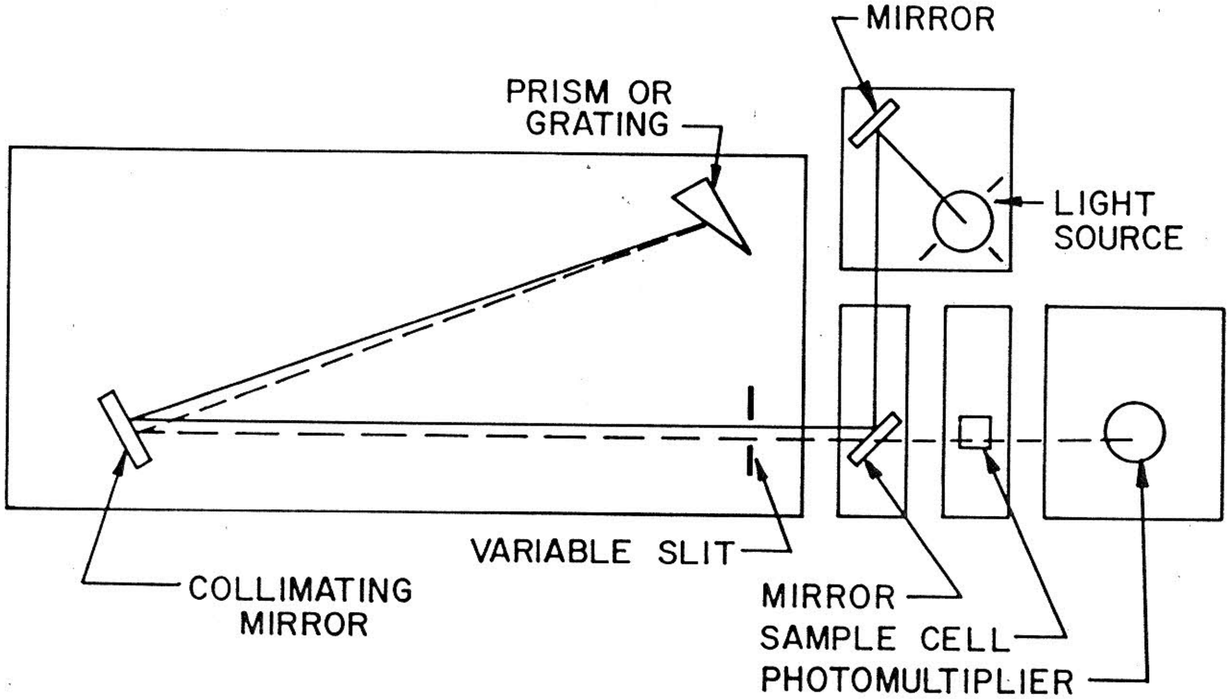


Figure 19-5. Schematic Diagram of Filter Photometer.



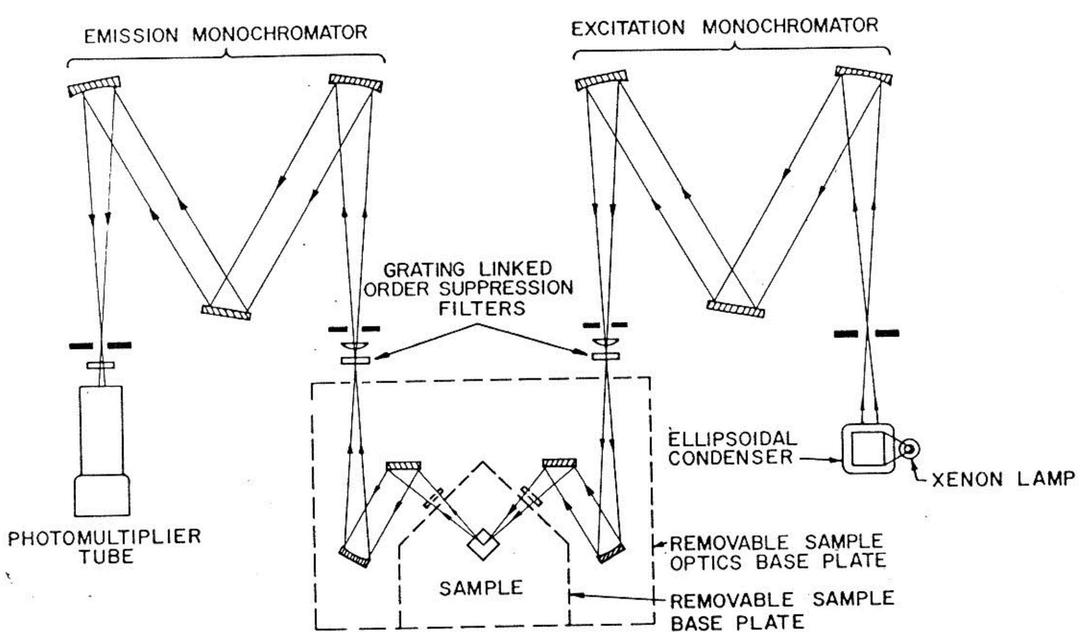
Cary Inst. Div. of Varian: Model 15 Optical Diagram. Monrovia, California.

Figure 19-9. Schematic Diagram of Double Beam Spectrophotometer.



Beckman Instruments, Inc.: Bulletin 134-D. Fullerton, California.

Figure 19-6. Schematic Diagram of Prism or Grating Spectrophotometer.



American Instruments Co.: Bulletins 2392H and 2423-1. Silver Springs, Maryland.

Figure 19-12. Schematic Diagram of Two Types of Spectrophotofluorometers.

INFRARED SPECTROSCOPY

Infrared energy

At either end of this visible spectrum are the invisible wavelengths. At longer wavelengths, just beyond the red end of the visible spectrum, is the *infrared* region (*infra* meaning frequencies *below* those of red light). Radiation in this region was demonstrated in 1800 by William Herschel, the English astronomer noted for his systematic studies of the stars and discovery of the planet Uranus.

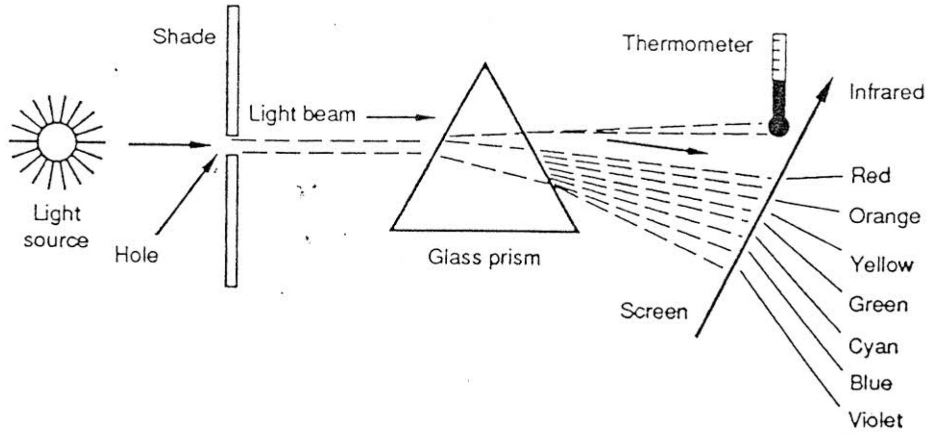


Figure 7.3 ***Herschel experiment.*** In 1800 William Herschel proved the existence of infrared energy using prism and a blackened thermometer.

Here is a completed table indicating wavenumbers for wavelengths given (all wavelengths are in micrometers – μm – and corresponding wavenumbers in cm^{-1} units. (Values *above the line* are within the MIRAN 1B's range limits.)

Wavelength μm	Wavenumber cm^{-1}
2.50	4000.
3.33	3003.
4.50	2222.
5.00	2000.
8.00	1250.
10.00	1000.
14.50	690.
15.00	666.7
20.00	500.
25.00	400.