Matter Waves

- 1923 – Louis de Broglie proposed that since photons have momentum, real particles could travel as waves
- stated that the wavelength could be found using Compton's idea for momentum:

$$\lambda = \frac{h}{p}$$

so,

$$\lambda = \frac{h}{mv}$$

- called the de Broglie wavelength
- a radical idea, but Einstein endorsed it
- de Broglie won the Nobel Prize in 1929 for his analysis of the electron

Example:

What is the de Broglie wavelength of a 0.6 kg baseball moving at 40 m/s?

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.63 \times 10^{-34}}{(0.6)(40)}$$

$$= 2.76 \times 10^{-35} \text{ m}$$

- in 1927, Davisson and Germer performed experiments to measure wavelengths of subatomic particles and confirmed de Broglie's claims
- matter wave theory led the way for the invention of the modern electron microscope by James Hillier (of Brantford) and Albert Prebus at U of T
- resolution is *MUCH* higher than with optical microscopes, because electrons have *MUCH* shorter wavelengths than light photons

Ant with Microchip
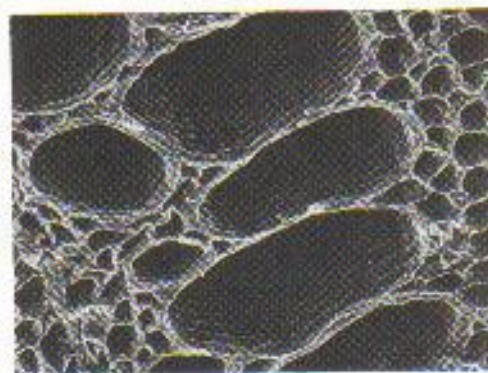
Plant Stem

(Images from an Electron Microscope)