Chapter 3: Ancient Astronomy

Mesopotamian Astronomy(as early as 4000 BC) [fig 3-1 ziggeraut]

- Predictions of seasonal changes for agriculture
  - source of "modern zodiac"
  - divided circle into 360 degrees, each degree into 60 minutes, each minute into 60 seconds
- Babylonian Astronomy (~500 BC)
  - Regularity in planetary and lunar motions (cycles)
    - Synodic cycles (relative to sun) vs. Sidereal (motion relative to the celestial sphere)
    - Records + Patterns allowed predictions of various planetary configurations [fig 3-2], lunar eclipses
    - Mathematical descriptions but NO attempt at explanation
  - primarily for astrology (pseudo-science)

More on Planetary Configurations [fig 3.2]

- Conjunction
  - Superior
  - Inferior
- Opposition
- Greatest Elongation (For Mercury and Venus, less than 180°)
- Quadrature

Egyptian Astronomy(as early as 4000 BC)

- Oriented towards practical (agriculture, seasonal predictions, construction of temples and monuments).
- Little record of Egyptian science and engineering
- Origin of (some) of early Greek Astronomy?

Early Greek Astronomy [fig 3-3]

Astronomers of Miletus (~600BC)

Thales: learned from Egyptians

purportedly predicted a solar eclipse

Anaxamander: developed a *physical description* of the cosmos. (Earth as a cylinder floating in space and the Sun, moon, stars, etc.. = fire filled wheels with holes.)

Anaximenes: stars are fixed to solid, crystalline vault surrounding earth. (precursor to celestial sphere)

=> these are the first mechanical explanations of celestial phenomena

{*more model building*}

Pythagoras and students(~550 BC) [fig 3-5]

Earth is a sphere

Earth and all celestial bodies move around central fire, unseen because earth is shielded by a "counter earth"

Celestial bodies (including earth) move along perfect circles (**symmetry**!) about the central fire

=> these ideas persisted in Greek Astronomy

Eudoxus (~400 BC) [fig 3-6]

Concentric spheres (with rotation relative to each other) designed to reproduce the details of planets' motions, including retrograde.

Aristotle (~350 BC) argued for

spherical earth

visibility of stars varies with location

shadow of earth on moon during eclipse is circular [fig 3-8]

"falling bodies move towards center of the earth" [fig 3-7]

spherical moon

phases of the moon due to illumination by the Sun [fig 2.19]

All celestial motion is circular, all celestial bodies are spheres

Later Greek Astronomy

Aristarchus (~250 BC): Geometry and Astronomy

described methods to

determine distance to the moon [fig 3-9],

the relative distances of the sun and the moon[fig 3-11,12].

improved upon by Hipparchus (~150 BC)

aside: small angle equation and distance [fig 3-10]

proposed that Sun is stationary, earth orbits sun

earth rotates, causing diurnal motions

(but, no stellar parallax was observed => evidence against Earth moving *around* the Sun)

[fig 3-13, "blink test" parallax_intro.avi, parallax_celestial_sphere.avi, parallax.avi]

parallax: apparent motion of an object caused by motion of the observer

Eratosthenes (~200 BC)

Used altitude of midday sun at different latitudes to determine circumference of the earth. [figure 3-14]

Hipparchus

Refinement of Aristarchus's methods

Extensive star catalogs

discovered precession of the equinoxes

(cycle of 26,000 years) [fig 3-15,16]

slow movement of celestial poles relative to stars

compared his star catalogs with those of earlier Greek astronomers

everyones modern astrological "sun sign" is wrong!

Ptolemy (~150 AD)

geocentric solar system model [3_17.mov, 0126.mov]

- perfect circles
- epicycle + deferent to describe prograde and retrograde planetary motion [fig 3-17,18 ptolemy_m.avi, ptolemy_v.avi]
- equant describes varying planetary speed [fig 3-19]

Chinese Astronomy [china09.jpg]

- Long record of observations (~2600 years)!
  - eclipses, comets, “guest stars”, meteor showers, etc
  - large amount of written information preserved

Mesoamerican Astronomy [IMG_0417.jpg,IMG_0438.jpg]

- Calendar included Sun, Moon and Venus
  - most records destroyed in Spanish conquest