Astronomers of the Mediterranean/Classical Era

Pythagoras of Samos (582 - 507 BCE)

- A system of concentric moving spheres. ("Music of the Spheres") Sphericity of heavenly bodies.
- A spherical Moon shines by reflection of sunlight. (Shape of terminator. Phases of the Moon.)
- The Pythagorean Theorem, of course!

Philolaus (c. 450 - 370 BCE)

- Concept of moving Earth - on mystical grounds ("Baseness")
- Cosmology: Nine spheres (Earth, 7 Luminaries, Fixed stars) moving about a "central fire". Star sphere and "fire" are fixed. Earth and everything else moves in some way.

Anaxagoras (499 - 428 BCE)

- Suggested planets were "other Earths" shining by reflected sunlight, like the Moon.
- Eclipses explained in terms of shadowing of sunlight by the Earth or Moon (*cf.* Pythagoras)

Democritus (c. 450 BCE)

- The Milky Way might be composed of many unresolved faint stars. (*cf.* Galileo)
- The stars are other Suns, scattered in an infinite three-dimensional space. (*cf.* Digges)
- Suggested that matter is composed of indivisible smallest pieces: Atoms and atomism.

Aristotle (384 - 322 BCE)

- Poet, dramatist, natural philosopher - and astronomer
- Constant angular sizes of the moving Sun & Moon implies the constancy of their distances.
- Solar eclipses then imply the Sun is always more distant than is the the Moon.
- Explanation of Lunar Phases. Eclipses explained with sunlight & shadows. (*cf.* Pythagoras)
- Sphericity of the Earth: Arguments for sphericity (and centrality) were based upon:
    * Changes in the appearance of the celestial sphere at different latitudes.
    * The "sinking" of receding objects; greater distances visible from heights.
    * Lunar eclipses: The Earth's always circular shadow.
    * Timing: An eclipse is seen at different solar times at different longitudes.
    * Ideas of "down" as centerward. The "perfection" of spheres. (...and elephants)
- Immobility of the Earth (Historical consequences!). Arguments based upon:
    * Absence of a "sense of motion" (Bad physics)
    * Arguments based upon winds and "falling off" (More bad physics)
    * Absence of curvature in paths of falling objects. (Yet more bad physics)
    * The absence of an observable stellar parallax. (Good geometry, but...)

Euclid (c. 300 BCE)

- Mathematician: Foundations of geometry (literally "Earth measuring").

Aristarchus (310 - c.230 BCE)

- A heliocentrist; believed the Earth went about the Sun, not *vice versa*. (A heretic!)
- Stars (other Suns) at enormous and various distance from the Sun (*cf.* ,Democritus & Digges)
- Determined sizes and distances of Earth, Moon, and Sun. (*via* Moon & eclipse observations.)

Eratosthenes (276 - 196 BCE)

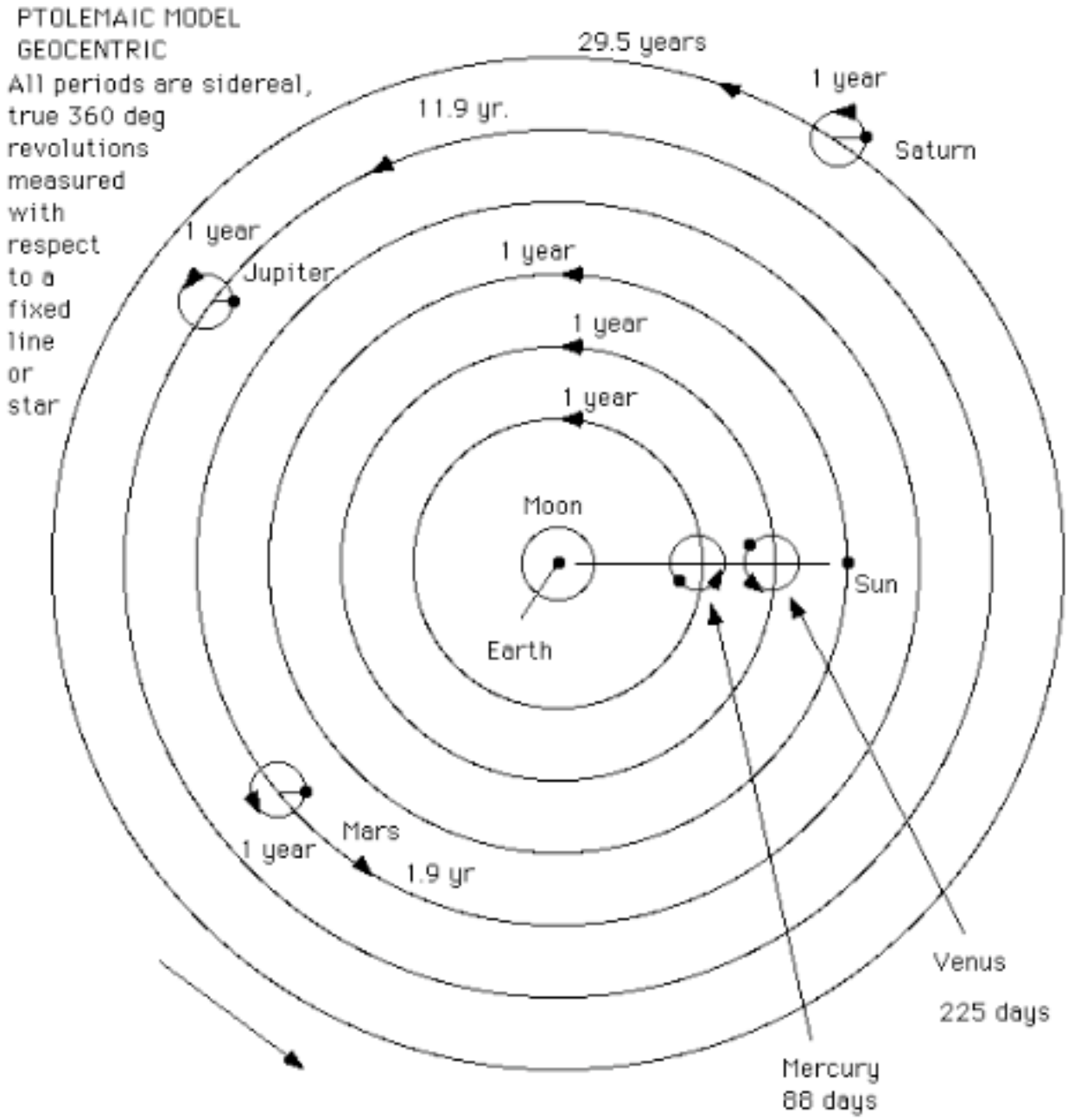
- Librarian at Alexandria. Determined Earth's size by measuring altitude of the Sun at two different latitudes. Note:**Posidinius** (35-51 BC) used the star Canopus to redo this.

Hipparchus (c.150 BCE)

- Measured positions of stars, Sun, Moon, planets on sky. (Observatory at Rhodes).
- Star Catalogue; 850 entries with positions and magnitudes.
- Determined length of year to 6±15 minutes.
- Discovered 25,800 year precession of the equinoxes.
- Refined Aristarchus' measurements of lunar distance. Found that Moon's distance varies.
- Devised accurate model to predict lunar and solar positions. Introduced epicycles.
- Could predict eclipse times to ±1 hr, and where on Earth solar eclipses would be visible.
- Used differences among solar eclipses (total *vs.* annular) to determine lunar distance and and its variations.(His lunar distances varied from 31 to 37 Earth diameters).

Ptolemy (c. 90-168 CE)

- Triangulation of Lunar Distance using Earth's diameter as a baseline.
- Compiled a 26 volume Encyclopedia of Astronomy ("The Great Treatise", "Almagest") containing "all astronomical knowledge" as well as his own synthesis which we call:
- The "Ptolemaic System" - a geocentric and geostatic model for the motions of the Sun, Moon, planets, and stars (celestial sphere). Epicyclical motions of planets (based on the ideas introduced by Hipparchus to explain the Moon's motion). This "System" survived 14+ centuries.



Claudius Ptolemy (ca. 100 - 170 A. D.), Alexandria. Published synthesis of greek astronomy in the ``Almagest''.

Note that the Celestial Sphere, with respect to which the above motions are referenced, is fixed in this figure. The counterclockwise (“eastward”) motion of the Sun, for instance, is with respect to the fixed stars. Relative to a static non-rotating Earth, the Celestial Sphere actually rotates clockwise with the sidereal period of 23h 56m 04s. As seen from the immobile Earth, the diurnal motions of the Sun, the Moon, and the motions of the centers of the planetary epicycles are all clockwise; the counterclockwise motions indicated above are only with respect to the “fixed” stars