

The Beginnings of Astronomy

The Earth-centered Universe



1



Beginnings of Astronomy

Pre-historic Monuments

- ☉ East-West-North-South
- ☉ Sunrise & sunset
 - ☉ Summer solstice: NE & NW
 - ☉ Equinoxes: E & W
 - ☉ Winter solstice: SE & SW
- ☉ Zenith passage Sun
 - ☉ Sun at zenith two days a year (tropics)

Stonehenge



Astronomy 20

2



Beginnings of Astronomy


The Pyramids



3

Beginnings of Astronomy


Stonehenge



Astronomy 20 4

Beginnings of Astronomy


Chichen Itza: El Castillo



Credit: Barry Hood
Astronomy 20 5

Beginnings of Astronomy

Chichen Itza: Caracol



Astronomy 20 6

Beginnings of Astronomy

Caracol

Diagram illustrating the Caracol observatory at Chichén Itzá, showing its circular structure and various astronomical alignments. Labels include: summer solstice sunset, northernmost Venus setting, zenith passage sunset, Pubic rising, summer solstice sunrise, eastern rising, Caracol rising, Fomalhaut setting, winter solstice sunset, and THE CARACOL CHICHÉN ITZA. A scale bar indicates 0 to 50 feet.

7

Beginnings of Astronomy

Babylonian Astronomy

- γ Constellations
- γ Lunar-solar calendar
- γ Planet appearances & disappearances
- γ Eclipse prediction

Table of eclipses recording the death of King Xerxes

Astronomy 20

8

Beginnings of Astronomy

Greek Astronomy

1. The shape of the Earth.
2. The size of the Earth.
3. The size and distance of the Moon.
4. Precise calculation of the motions of the Sun, Moon, and planets.

Astronomy 20

9

Beginnings of Astronomy

Eratosthenes: Size of Earth

Astronomy 20 10

Beginnings of Astronomy

What's in the Center?

- Two Questions
- 1) Does the Earth rotate or the Celestial Sphere?
- 2) Does the Earth go around the Sun or the Sun go around the Earth?

Astronomy 20 11

Beginnings of Astronomy

Aristotle

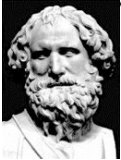
- The Celestial Sphere rotates.
- The Sun moves around the Earth.
- The Earth is completely stationary.

Astronomy 20 12

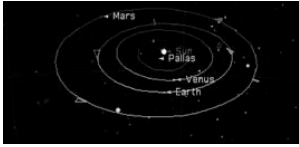
Beginnings of Astronomy

Aristarchos

- ☛ According to Archimedes, taught:
 - 1) The Earth rotates on its axis.
 - 2) The Earth moves around the Sun.



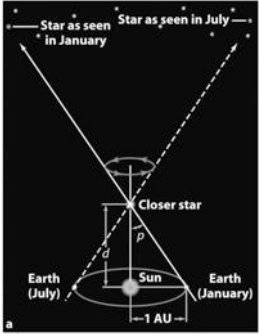
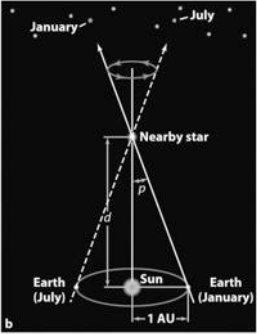
Archimedes



Astronomy 20 13

Beginnings of Astronomy


The Stellar Parallax

Beginnings of Astronomy

Ptolemy

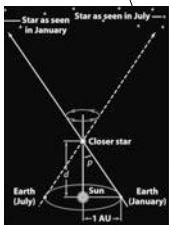
- ☛ The Great Astronomer - 150 AD
- ☛ the *Almagest*—astronomy textbook
- ☛ Found *no* stellar parallax.
- ☛ Argued *against* Aristarchos.
- ☛ Developed theory of motion of the planets.



Astronomy 20 15

Beginnings of Astronomy

Stellar Parallax



Q. *The failure to observe the stellar parallax proved that...*


- The Sun went around the Earth.
- The Earth went around the Sun.
- Either the Sun goes around the Earth or the stars are very far away.

Astronomy 20 16

Beginnings of Astronomy

The Problem of Planetary Motion

- Why do the inferior planets never reach opposition?
- Why do the superior planets go backward (retrograde) at opposition?

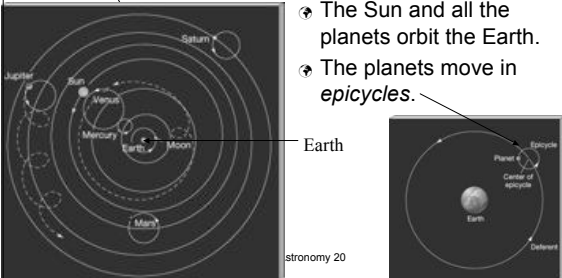


Retrograde motion of Mars

Astronomy 20 17

Beginnings of Astronomy

The Ptolemaic Theory



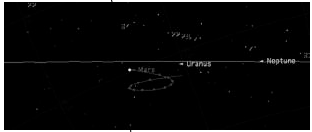
- The Earth is the center.
- The Sun and all the planets orbit the Earth.
- The planets move in *epicycles*.

Astronomy 20

Beginnings of Astronomy

Unanswered Questions

- Why do the superior planets go into retrograde *only* at opposition?
- Why do the inferior planets go into retrograde *only* at inferior conjunction?



Astronomy 20 19

Beginnings of Astronomy


The Dark Ages

Astronomy 20 20


Beginnings of Astronomy

Islamic Astronomy

- Al Farghani (850): Earth's circumference
- Al Battani (900): precession of perihelion
- Al Sufi (950): new star catalog
- Al Hassan (1000): planetary theory and optics
- Al Tusi (1260): Maragha Observatory
- Ulugh Begh (1428): great observatory in Samarkand



Al Hassan




Ulugh Begh

Astronomy 20 21

Beginnings of Astronomy

Chinese Astronomy




Armillary sphere,
Beijing Observatory
1600s

22

Beginnings of Astronomy

Indian Astronomy




Jaipur Observatory (1700s) Astronomy 20

23

Beginnings of Astronomy

Astronomy in 1500

- ❖ Earth-centered model unquestioned.
- ❖ *Alphonsine Tables* (1252) used to calculate planet motions.
- ❖ Planets often far from predicted positions.



Astronomy 20

24
