Greek Astronomy / Motions of the sky

- Erathosthenes' measurement of the Earth
- Hipparchus' measurement of distance to the moon
- Motions of the sky that we have seen with our naked eyes. A model to explain the motions.

- Homework 1
  - Due Mon, Sept 14. (Delayed one class.)
  - Missouri Club on Fri, Sept 11. Show me …
  - You may work with your Ast207 buddies, but you must write your own homework. (No copies.)

Erathosthenes ~200 BC

- A correspondent in Syene reports that at noon on the summer solstice, the sun illuminates the bottom of a well. In Alexandria (where Erathosthenes lived), a stick makes at 7° shadow.
- It takes a camel 50 days to travel from Syene to Alexandria. A camel can travel 100 stadia/day.

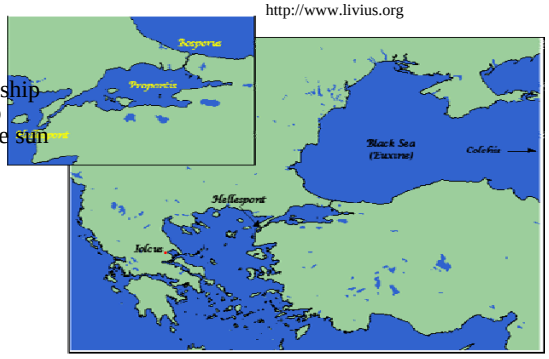
1. The distance between Alexandria & Syene is 500 km?
2. Draw a picture to show the relationship between the sun, the well, the stick, and the two locations. "A clear picture is 90% of clear thinking."

- Picture shows Alexandria & Syene are 7° apart in latitude.
- The circumference is 360° around Earth
  - 500km ×360°/7°=25,000km
- Actual circumference is 40,000km.

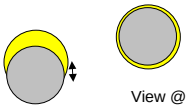
Hipparchus measures the moon's distance~200BC

- At the Hellespont, the solar eclipse of 189BC was total. (Sparta defeated Athens there in 405 BC.)
- In Alexandria, the moon covered ¾ of the sun. Alexandria is 1000km from the Hellespont.
- The diameter of the sun is ½ degree. In Alexandria, the angle between the sun and moon is ¼*1/2=1/8 degree.
- "A clear picture is 90% of clear thinking."
- Draw a picture to show the relationship between the sun, the moon, the two locations, and the angle between the sun and moon in Alexandria.

http://www.livius.org



http://mkatz.web.wesleyan.edu/medea_lecture/hellespont.gif



View @ Hellespont

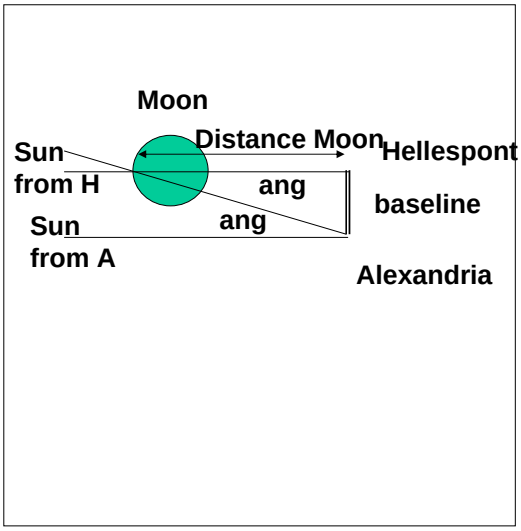
View in Alexandria. Moon is offset by 1/4 diameter of sun

What triangle did Hipparchus use?

- Parts of triangle
  - Angle is due to parallax: moon in foreground shifts with respect to sun in the background.
  - One leg of triangle is the baseline.
  - Other leg is distance to moon.
- Small-angle approximation

  Angle = Baseline/Distance
  - Angle must be in radians
    - 180° in π rad
    - 57°/rad
- Find distance

  Distance = Baseline/Angle



- Small-angle approximation

  Angle = Baseline/Distance
  - Angle must be in radians
    - 180° in π rad
    - 57°/rad

1. From Alexandria to the Hellespont, the angle between the sun and moon shifts by 1/8°. What is the shift in radians? Explain how to do this without remembering a formula.

   A. 1/8 rad

   B. 57/8 = 6 rad

   C. 1/8/57=1/440 rad

- Parts of triangle
  - Angle is due to parallax: moon in foreground shifts with respect to sun in the background.
  - One leg of triangle is the baseline.
  - Other leg is distance to moon.
- Small-angle approximation

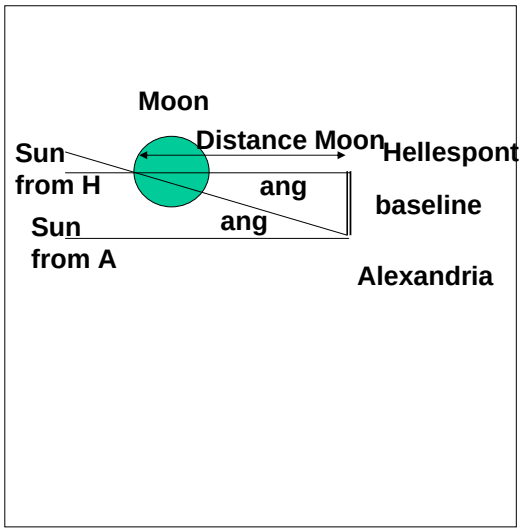
  Angle = Baseline/Distance
  - Angle must be in radians
    - 180° in π rad
    - 57°/rad
- Find distance

  Distance = Baseline/Angle

  angle = 1/440 rad

  D = 1000km 440 = 440,000km

What triangle did Hipparchus use?



Changes in the Sky

- Name two motions of objects in the sky or changes in the sky that you have observed.

Changes in the Sky

- The sun sets south of west in winter.
- Winter days are short.
- Stars move east to west over a night.
- The constellations change over the months.
- The sun (and moon and stars) rises & sets.
- The sun is higher in the sky in summer than winter.
- Planets move with respect to the stars.
- Comets appear irregularly.