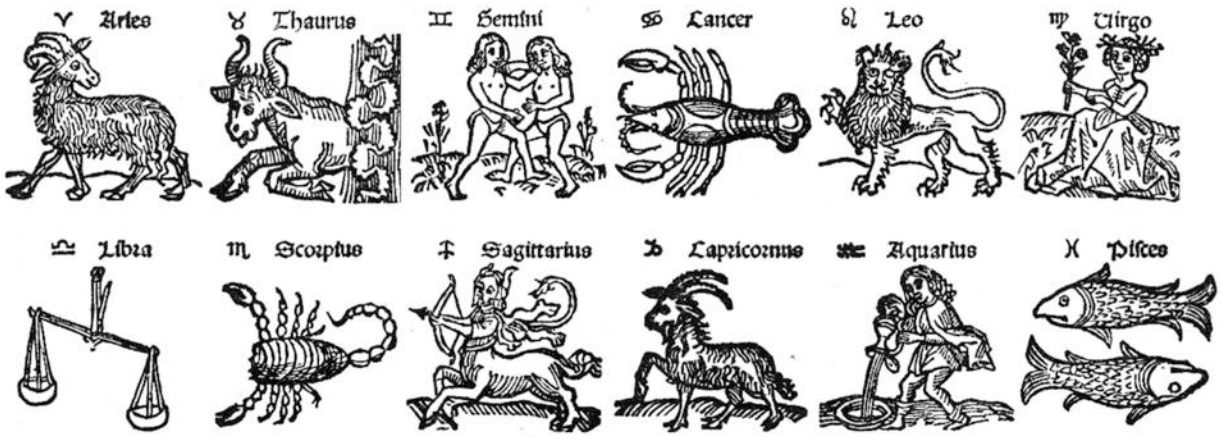
QUADRIVIUM

Assignment 11b: ASTRONOMY
Geometry in Motion
for
Annandale Thursday, April 18th
or
Fishkill Friday, April 26th



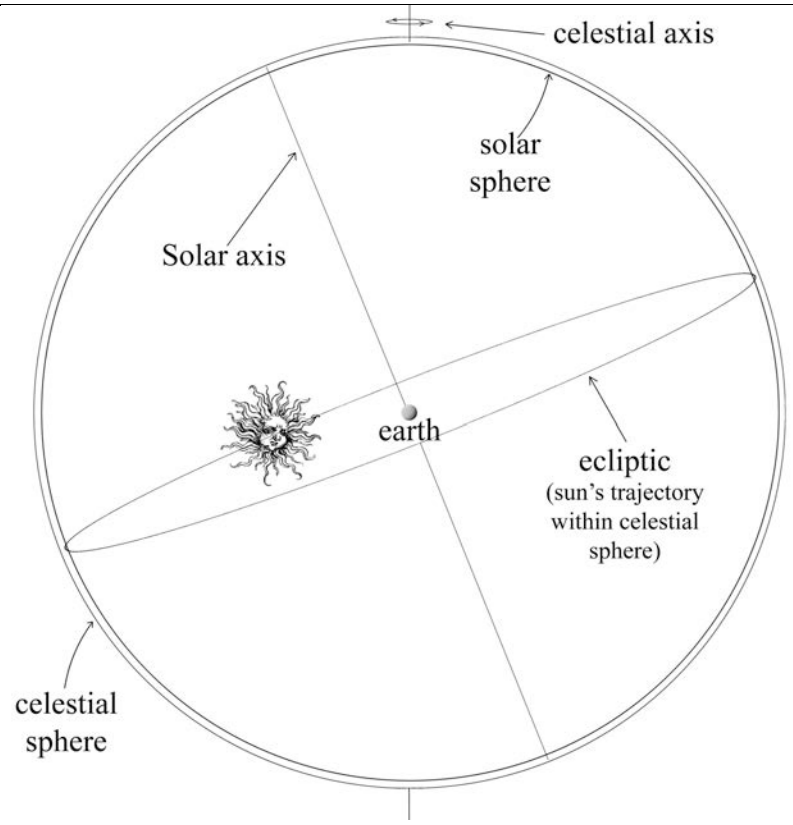
Read and do the following:
-Newsome, "Quadrivial Pursuits." Read pp. 10-15, an overview of Quadrivial Astronomy and Astrology. Pay close attention to all the descriptions of Fig. 2.9. Try to keep track of all the moving parts... the ecliptic, horizon, sphere of fixed stars, the zodiac, etc.
-Grant Medieval Sourcebook- In Volume II Reader Read Ch2 from Sacrobosco's (d. ca. 144-1256): *Sphere*, "The Circles and Their Names," which starts at the bottom of p. 445 and goes to the end of p. 449. Sacrobosco's *Sphere* was the book that nearly everyone read to learn undergraduate astronomy.
Assignment for Thursday-Annandale or Friday-Fishkill: 1) Draw all the zodiacal and planetary signs a few times and try to memorize them. 2) Come up with a better mnemonic to remember the signs of the zodiac. The standard one is quoted below. I can never remember it. We'll try yours out in class and see if you come up with something memorable. 3) Figure out how long the shutter was open on the time exposure photograph attached to this doc.

ALL THE GREAT CONSTELLATIONS LIVE VERY LONG SINCE STARS CAN'T ALTER PHYSICS

Aries ♈	Cancer ♋	Libra ♎	Capricornus ♑
Taurus ♉	Leo ♌	Scorpio ♏	Aquarius ♒
Gemini ♊	Virgo ♍	Sagittarius ♐	Pisces ♓

Sun ☉	Saturn ♄	Venus ♀
Moon ☾	Jupiter ♃	Mercury ☿
	Mars ♂	

The symbol for Saturn is sort of the symbol for Jupiter flipped over. Also it is sort of a sickle/scythe, symbolic of harvest or death. Jupiter is Zeus in Greek mythology, and it's symbol is sort of a "Z" with a vertical line through it.



The celestial sphere rotates once per day.

The solar sphere rotates once per year.

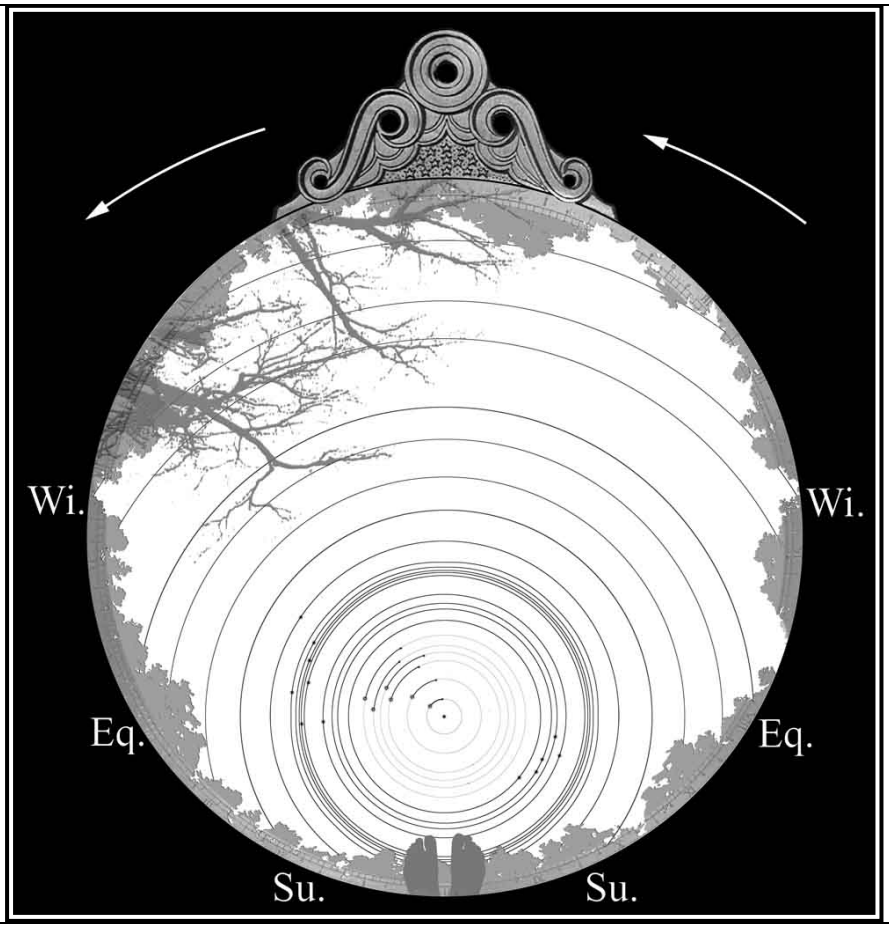


Figure 2.7:
The Cosmos from a Terrestrial Point of View

The Little and Big Dippers and Cassiopeia are shown near the rotational center, the North Celestial Pole (NCP). Star trails segments emphasized for the Little Dipper are ca. 3 hrs.

I have oriented the eastern horizon on the right to follow modern conventions. For brevity, I am not going to discuss stereographic projection, which would require a specialized essay of its own. Circles Su. and Wi. are approximately the paths of the summer and winter suns and Eq. is roughly the path of the sun on the vernal and autumnal equinoxes.

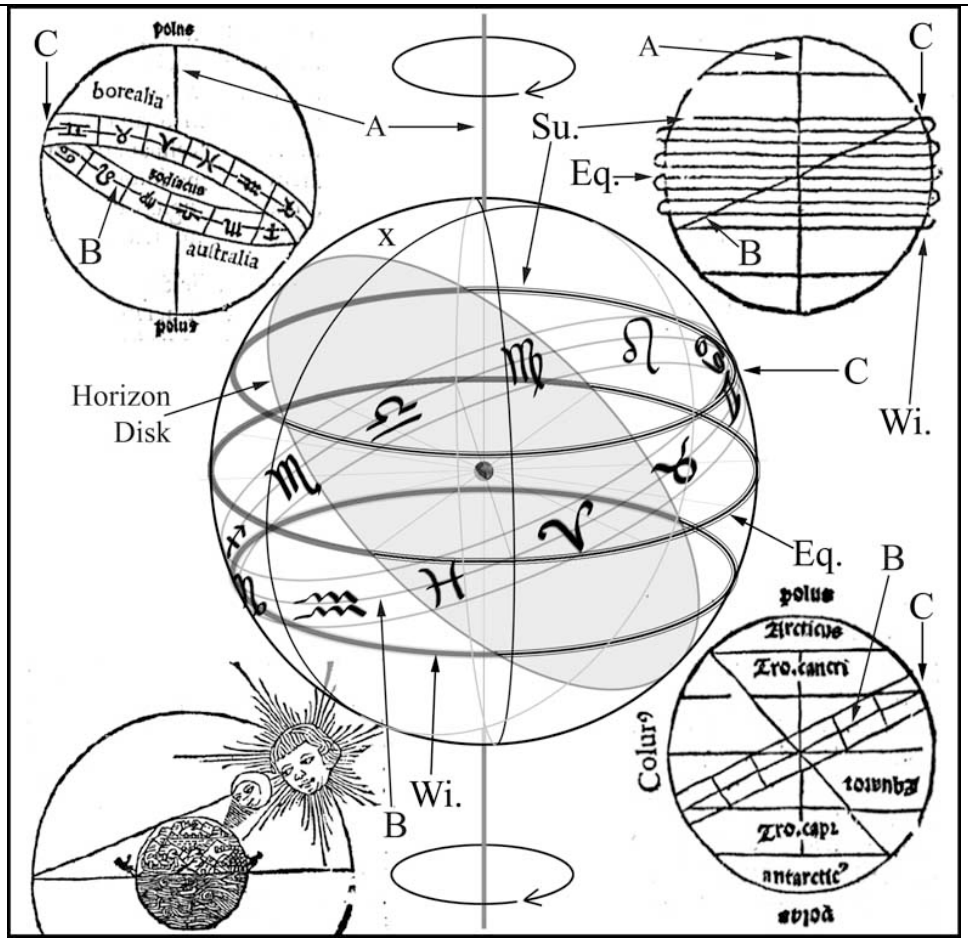


Figure 2.9:
Views of the Cosmos

The four woodcuts in the corners are from a printed edition of Sacrobosco's *Sphere* (Venice, 1508). (The woodcut in the upper left should be horizontally flipped to be accurate. This is a woodcutter error.) In the central diagram the earth and its horizon are stationary and the outer sphere of the fixed stars along with the sun spin on the vertical axis once per day. The moon and planets also spin with the stars, but are not indicated in this diagram.

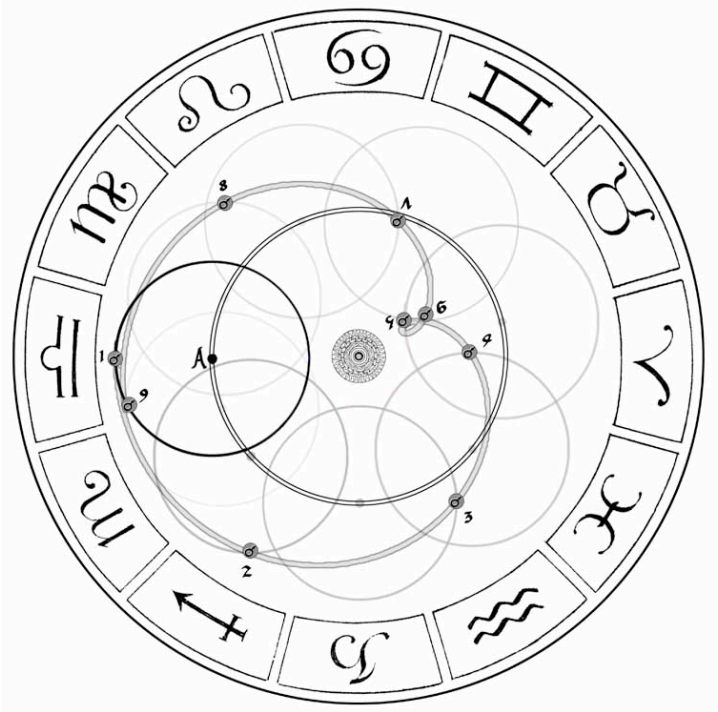
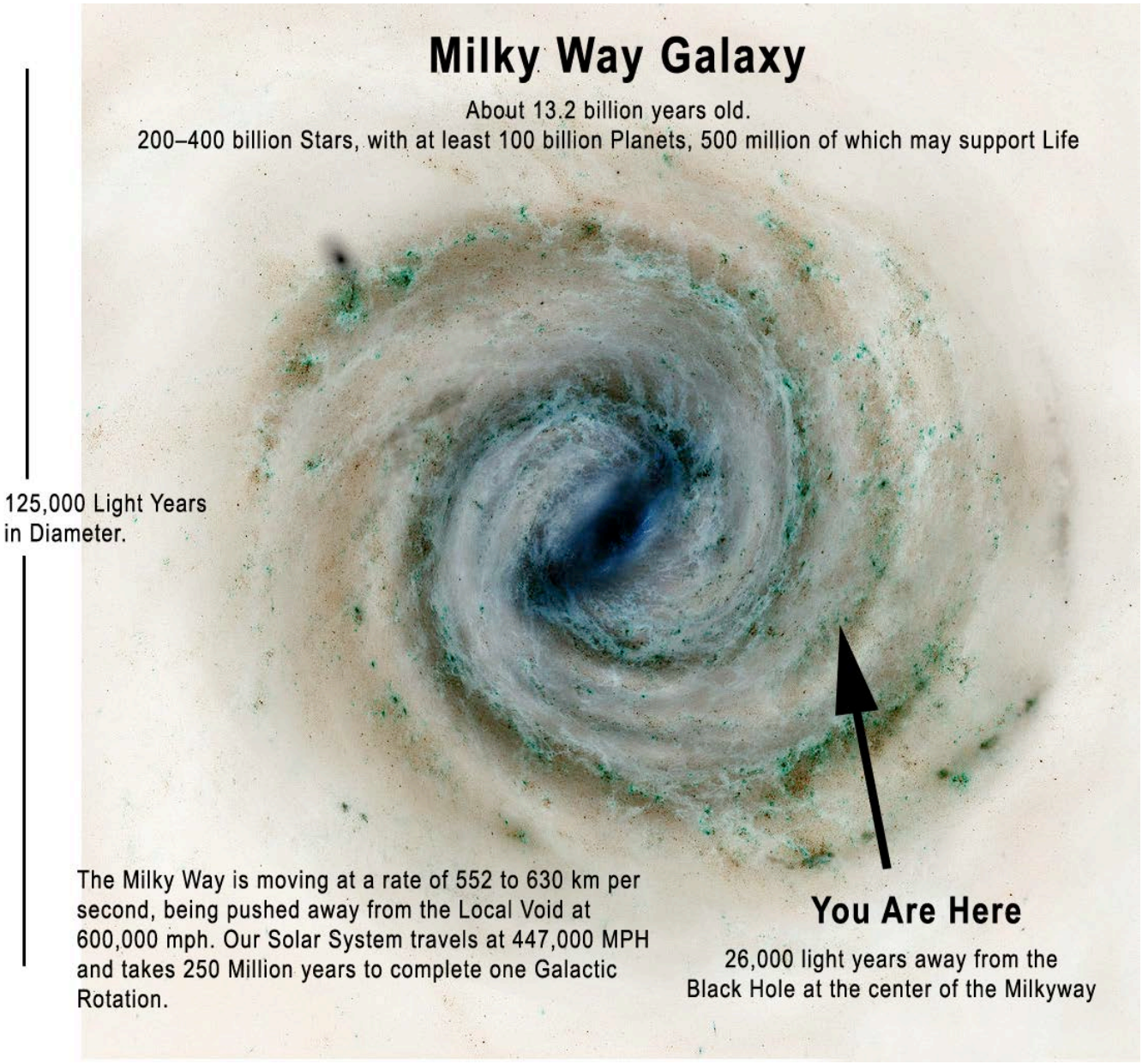


Figure 2.10:
Martian Epicycle Seen from the "Northern" Ecliptic Pole

Earth is in the center and Mars is initially located at 9:00 on its first epicycle and 9:00 on its deferent. All rotations are counterclockwise. The motion of this epicycle is shown in three-month snapshots all lightly superimposed on this diagram. The retrograde motion is evident in the trajectory at about 2:00 on the deferent, between positions 4 and 6. Numbered Martian locations are three months apart.



Calling this "The Milky Way Galaxy" is like the Department of Redundancy Department.
Gala is Greek for milk.

Astronomers estimate that there are about 100,000,000,000 galaxies in the universe.
That's 100 billion.

Back of the envelope calculation: If there are 100,000,000,000 galaxies and 200,000,000,000 stars in each galaxy, how many stars are there in the universe.

2×10^{22} stars
20 sextillion stars
If .0025 (0.25%) of these stars have habitable planets,
how many planets in the universe could support life?
5×10^{19} habitable planets.
50,000,000,000,000,000,000
50 quintillion.

HW-11b:
Left: Here is a time-exposure photograph of the night sky. Without using a protractor, your task is to estimate how long the time-exposure was.
Hint: fold the paper in such a way as to determine pie-slices.

To help you with this task I've provided an inverted and enlarged version of this photo (below).