The ‘Two Sphere’ Universe

- So far lots of data, but how to explain it?
- i.e. how to construct a theory that yields and unifies the disparate data?
- A very ancient *framework* – already by 4th C B.C.

The ‘Two Sphere’ Universe- the stars

- Sphere of the stars
- Role of observation and symmetry considerations
- Natural then that earth is also spherical and also of course at the centre (also observation)

The ‘Two Sphere’ Universe- the stars

- Figure 11

The ‘Two Sphere’ Universe- the stars

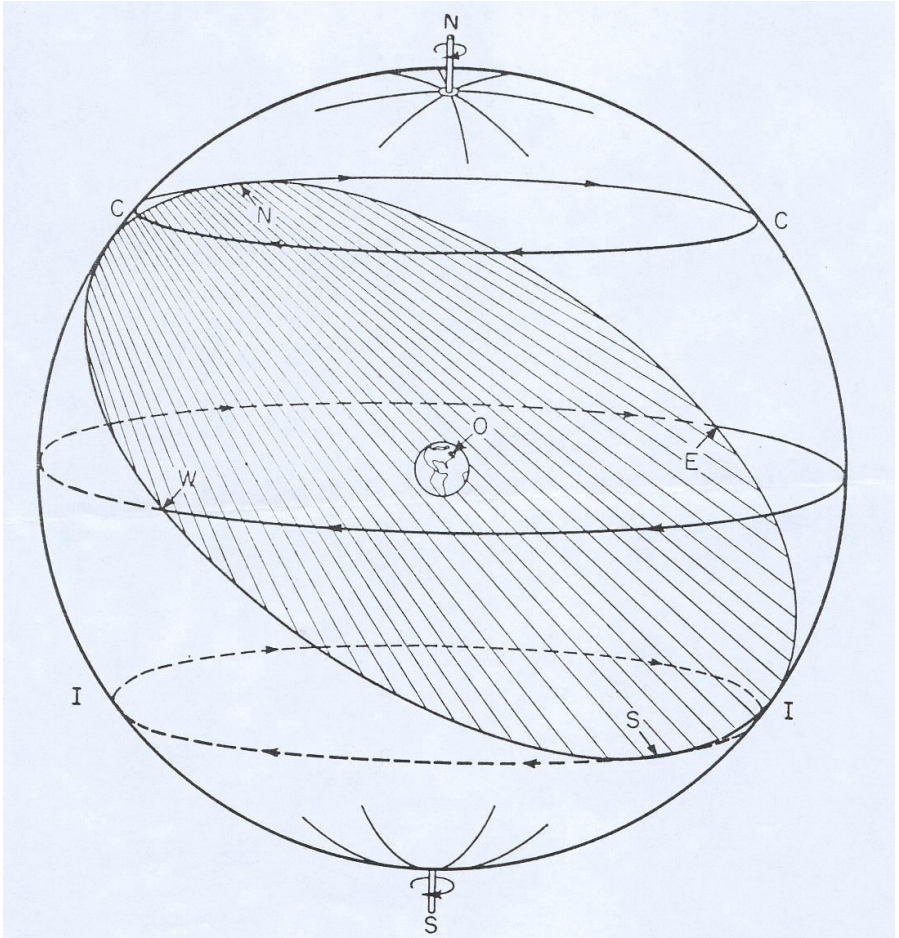

Figure 11. Astronomical functions of the two-sphere universe. The outermost

The ‘Two Sphere’ Universe- the stars

- Figure 11
- Explanation of stars’ motion
- Figure 12

The ‘Two Sphere’ Universe- the stars

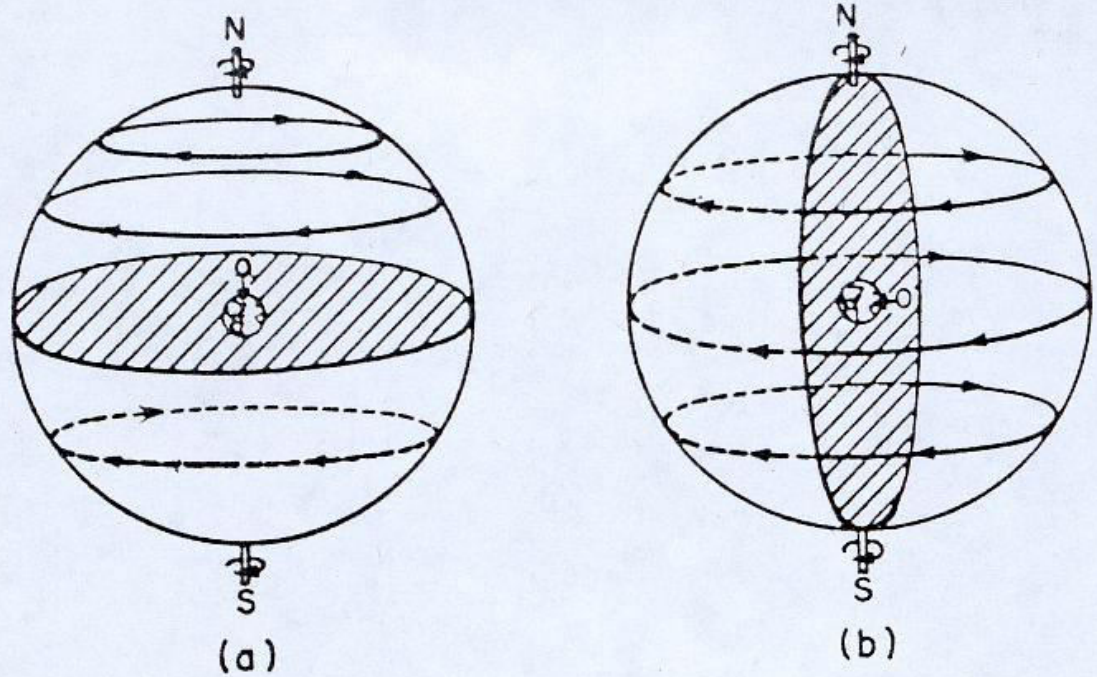

Figure 12. Stellar motions in the two-sphere universe as seen by an observer (a) at the north terrestrial pole and (b) at the equator.

The ‘Two Sphere’ Universe- the stars

- Figure 11
- Explanation of stars’ motion
- Figure 12
- Notice clear predictive success (realism)

The ‘Two Sphere’ Universe- the sun

- Figure 13

The ‘Two Sphere’ Universe- the sun

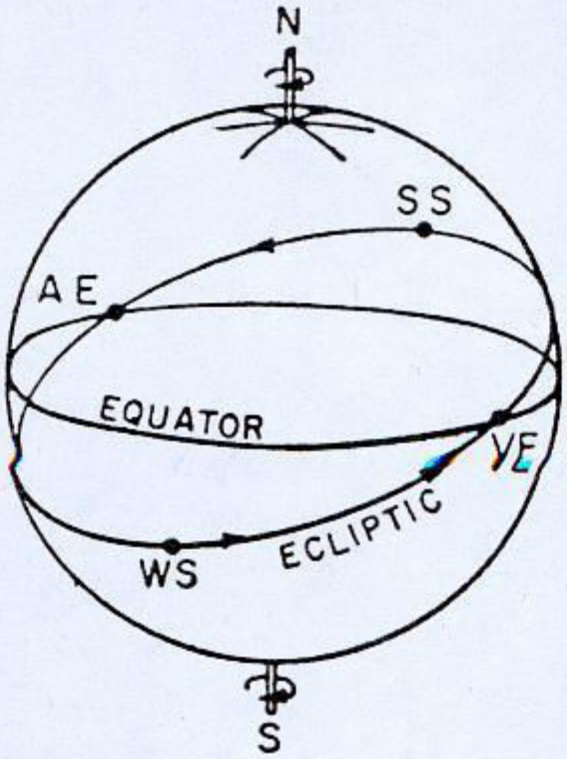

Figure 13. The equator and the ecliptic on the celestial sphere.

The ‘Two Sphere’ Universe- the sun

- Figure 13
- Ecliptic a great circle on the stellar sphere
- Celestial equator
- Remember double motion of sun
- Must slip back just under 1^{o} per day –> 4 minute “prediction”

The ‘Two Sphere’ Universe- the sun

- Equinoxes and Solstices
- Figure 14 – again predictive success

The ‘Two Sphere’ Universe- the sun

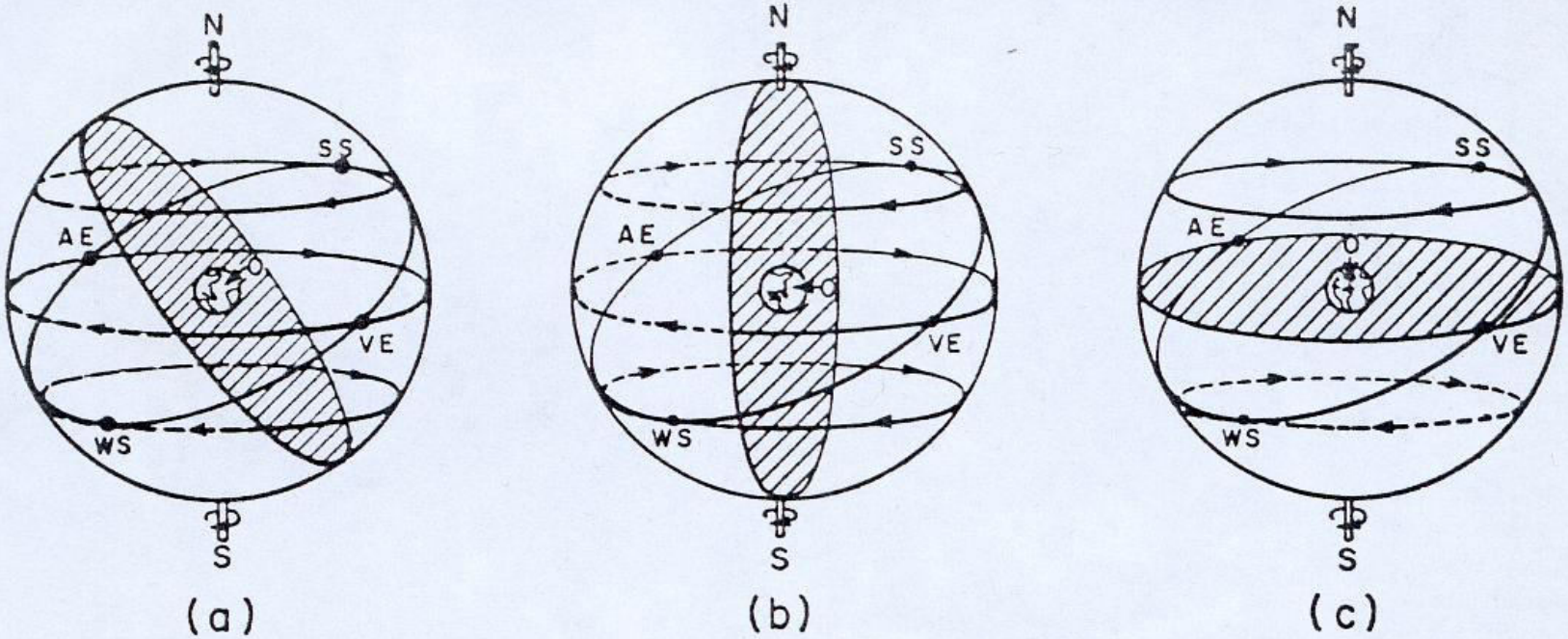

Figure 14. The motion of the sun observed from different locations on the earth.

The ‘Two Sphere’ Universe- the sun

- Equinoxes and Solstices
- Figure 14 – again predictive success
- Were competitors to 2 sphere view – inc Aristarchus
- Seemed hopeless in view of
- (i) observation
- (ii) Distinction between celestial and terrestrial realms
- (iii) No sign of earth’s motion

The Planets

- Planet = Wanderer

- Sun, Moon, Mercury, Venus, Mars, Jupiter and Saturn

The Planets

- All move, to a first approximation, like the sun –
- I.e. westward diurnal motion with the stars with a superimposed eastward motion
- Very seldom outside band of zodiac
- **Moon** moves round the ecliptic more quickly and less steadily than the sun
- Gets round in $27^{1/3}$ days on average – though time for any individual journey can differ from average by up to 7 hours

The Planets

- The other planets similarly
- 1. Unlike sun, don’t stick to ecliptic in their eastward motion
- 2. That motion occurs at a far from uniform rate – the other planets exhibit much greater irregularities than the moon.

The Planets

- 3. Average ‘orbits’
- Mercury = Venus (= Sun) = 1 year
- Mars = 687 days
- Jupiter = 12 years
- Saturn = 29 years
- But very wide variations from these means
- 4. Above all – STATIONS AND RETROGRESSIONS

The planets

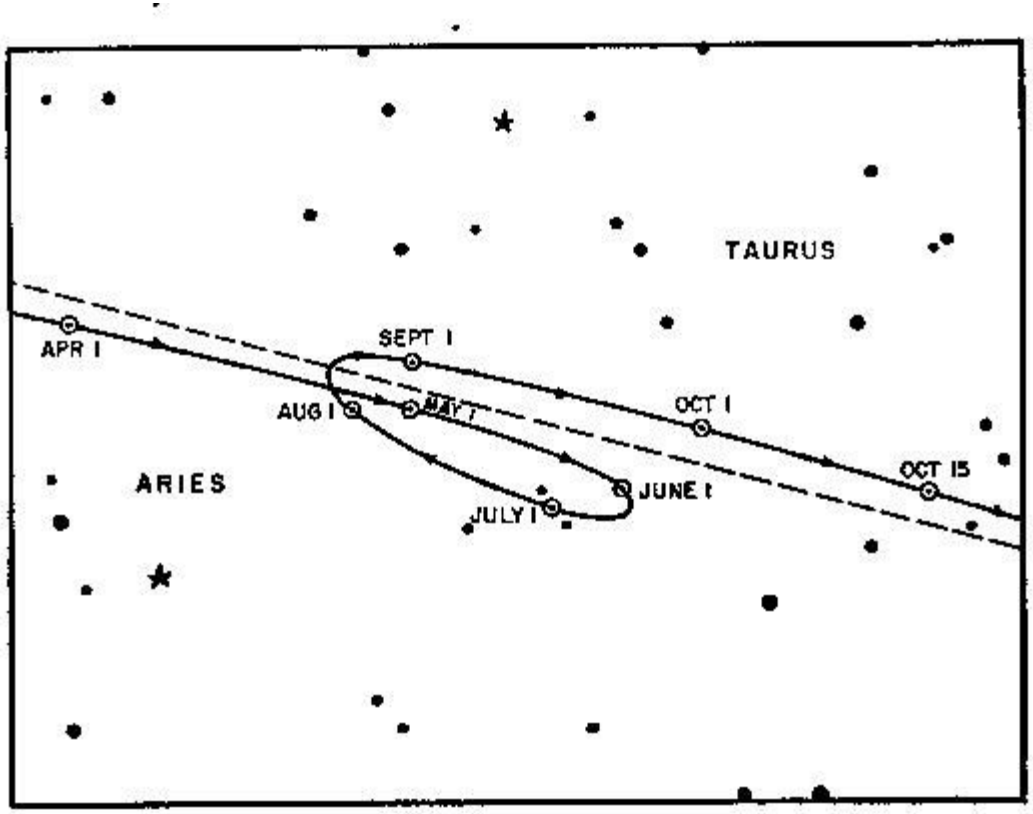

Figure 15. Mars retrogressing in Aries and Taurus. The section of sky is the same as that shown in Figure 9 and in the box on the star map of Figure 8. The broken line is the ecliptic and the solid line the path of the planet. Note that Mars does not stay on the ecliptic and that, though its over-all motion is eastward among the stars, there is a period from the middle of June to early August during which it moves to the west. The retrogressions of Mars are always of approxi-

The planets

- Figure 15
- Mercury every 116 days
- Venus 584 days
- Mars 780 days
- Jupiter 399 days
- Saturn 378 days

The Planets

- Another important phenomenon/distinction
- BOUNDED ELONGATION of Mercury and Venus (28^o and 45^o)
- Morning star/ Evening Star

The Planets

- Others quite different can be anywhere on ecliptic/zodiac compared to sun
- Important interrelations –
- 1.“superior” planets only retrogress when in “opposition”
- 2. Are at their brightest (nearest?) when retrogressing

The Planets

- Order of the planets – figure 16

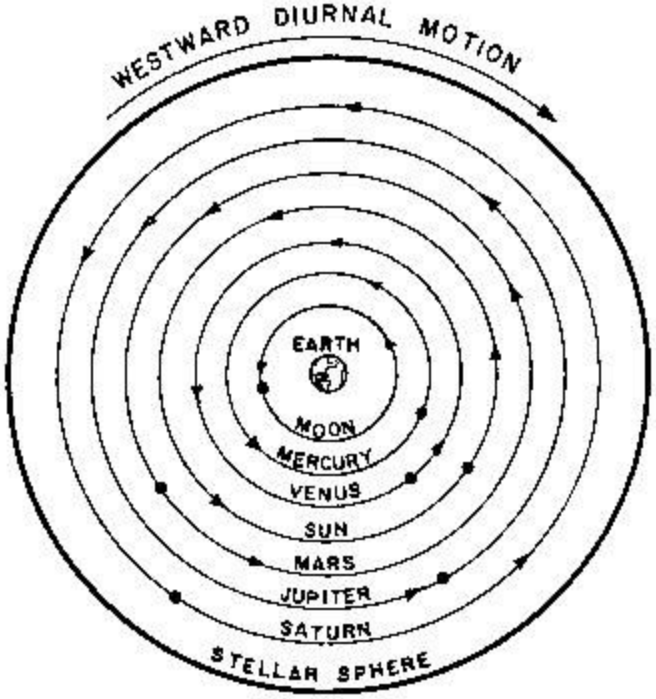

Figure 16. Approximate planetary orbits in the two-sphere universe. The outermost circle is a cross section of the stellar sphere in the plane of the ecliptic.

The Planets

- Order of the planets – figure 16

- Note abitrariness about sun, Venus and Mercury