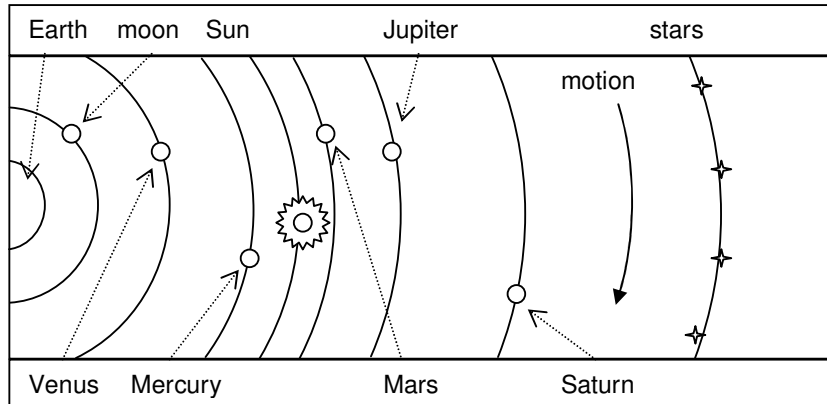
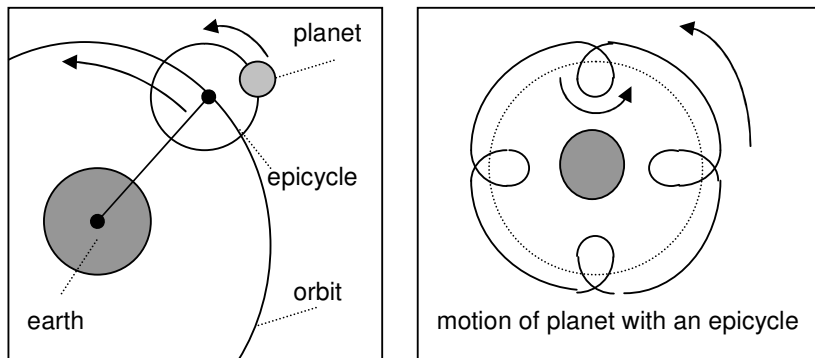


the Ptolemaic model of the universe

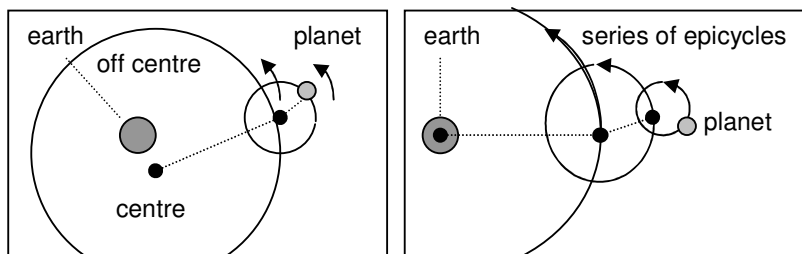
- the **Ptolemaic** model starts with the earth at rest in the centre.
- the earth was considered far too heavy to move!
- it is also called the **geocentric** model as the earth is at the centre.
- all objects orbit the earth in perfect circles at a constant speed.
- the stars are fixed to a celestial sphere that orbits in 24h.
- all motion is from east to west.
- all bodies moves slightly slower than the celestial sphere.



- this simple model was modified as predictions didn't fit observations.
- epicycles account for the retrograde motion of some planets.
- an **epicycle** is a circle whose centre lies on the planet's circular orbit.
- the centre of the epicycle moves at a constant speed round the orbit.
- the planet moves around the epicycle at a constant speed.
- while the centre of the epicycle always moves forwards, the planet can be moving backwards on the epicycle and will show retrograde motion against the stars. See below:

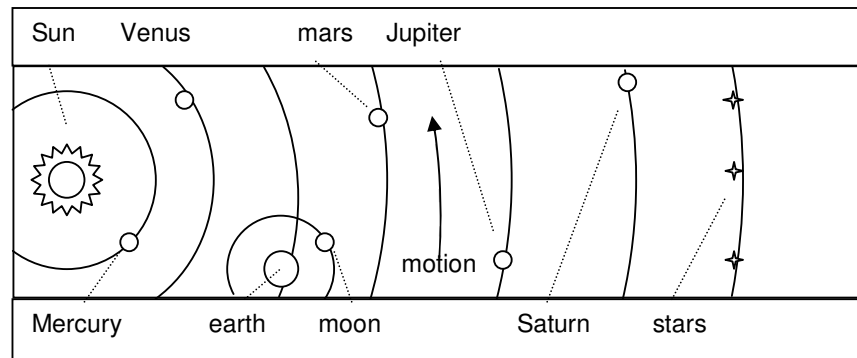


- the addition of epicycles gave better predictions to planetary movements.
- predictions still disagreed with observation so **eccentric** circles were used.
- in this version, the earth is not at the centre of the epicycle's orbit.
- instead, the earth is slightly displaced to one side. Predictions were better.
- further epicycles were added to the model to keep up with observations.



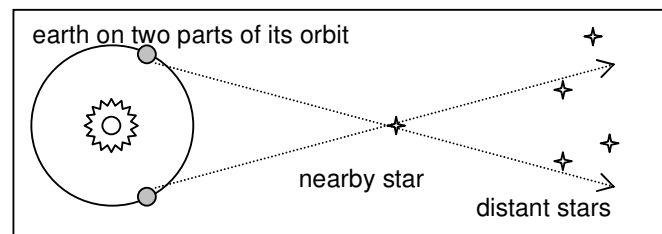
the Copernican model

- at around the same time as Ptolemy, another model of the universe existed.
- Aristarchus** had shown the earth was round and measured the diameter.
- he said that the sun could be the centre of the universe, not the earth.
- as far as observation, it would change nothing if the earth orbited the sun.
- his idea was little known and Ptolemy's model had much more support.
- as time passed, the difference between the planets' predicted and actual positions increased.
- to compensate for this more and more epicycles were added.
- Copernicus** looked for simplicity, reasoning that the existing model was now very complicated and pointing out that the earth, though large, relied on the sun for its heat and light and he put the sun at the centre of his model.
- the sun is sat the centre of the universe and the earth orbits the sun.
- all bodies orbit the sun in perfect circles at a constant speed.
- the moon orbits the earth in a perfect circle at constant speed.
- as the sun is the centre, this is called the **heliocentric** model.
- the earth turned on its own axis every 24hr, not the stars.
- the model of Copernicus predicted the positions of the planets as accurately as the Ptolemaic model, but it was more simple.
- Copernicus needed to retain some epicycles for more accuracy.
- Copernicus was aware that his ideas contradicted the Church.
- the Church still put the earth at the centre due to interpretations of the Bible.
- Copernicus said his model was merely a tool for calculation and not reality.
- his paper was published quietly and late in his life, raising little attention.



the pros and cons of the the heliocentric model

- the heliocentric model was better than the geocentric being more simple.
- it did away with almost all the epicycles and eccentrics.
- it made sense that the larger body, the sun was at the centre, not earth.
- it went against the teaching of the Church, a strong force at the time.
- it predicted phases for mercury and Venus, later seen by Galileo.
- with the heliocentric model, a moving earth predicted the parallax of the stars, which was not observed. See below.



- seen from two different points on the earth's orbit, a nearby star should appear to move against the more distant stars.