Basic Ptolemaic System
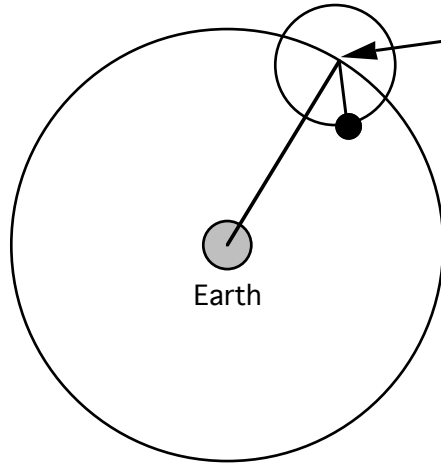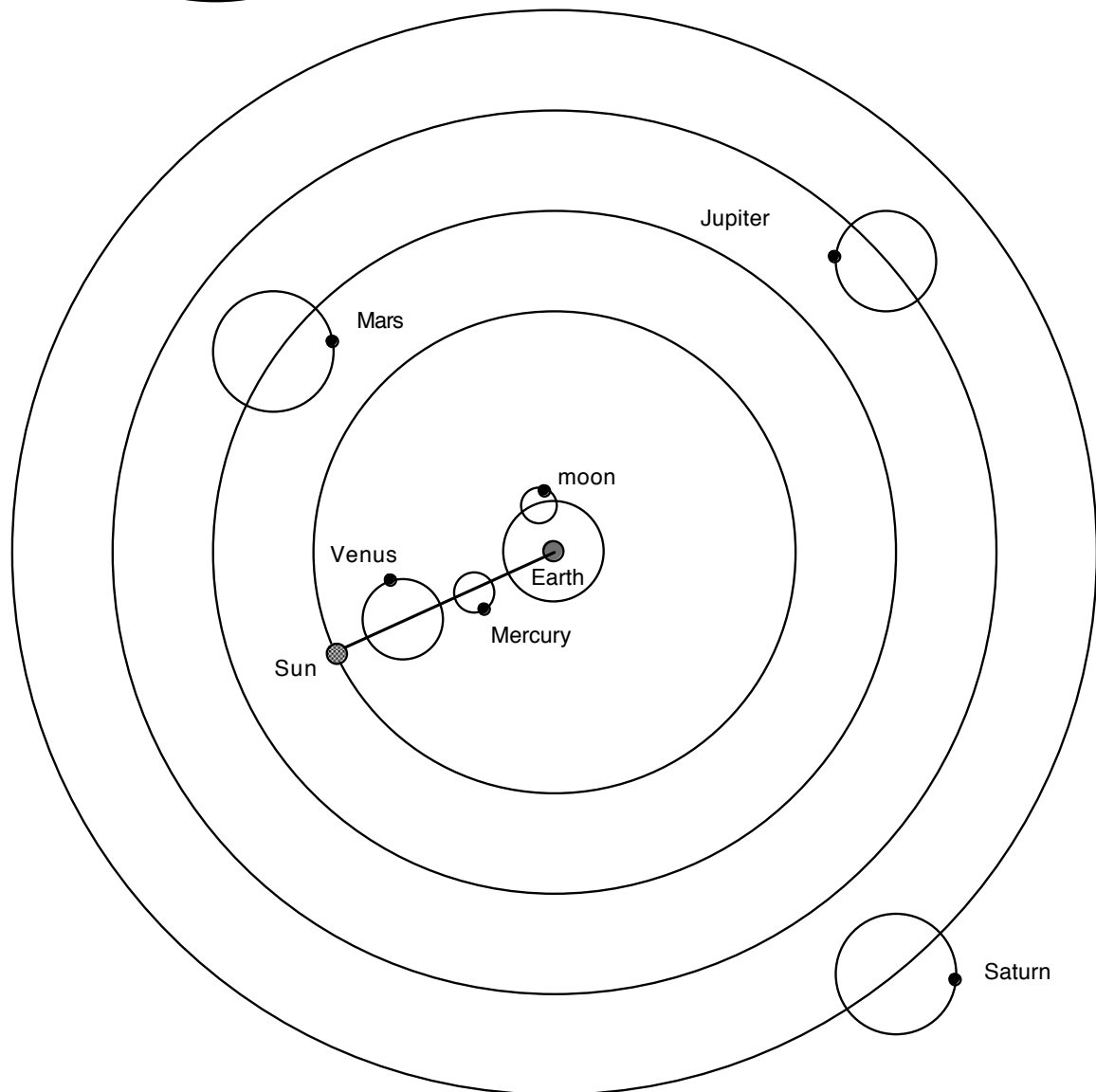
Planet revolves around this point;
this point revolves around the earth.
Both revolutions are in the same
direction.

Earth

The small circle is called the epicycle.
The large circle is called the deferent.

Jupiter

Mars

moon

Venus

Earth

Mercury

Sun

Saturn

Basic Ptolemaic System

Apollonius produced a large volume of work on conic sections, and proved several theorems used by later astronomers. Though he never actually applied his math to astronomical calculations, he made several important discoveries relating the motion of an epicycle on a deferent. Epicycles were applied to astronomy by Hipparchus, who also introduced the idea of the eccentric to explain the difference in the length of the seasons. (He applied the eccentric to the motion of the sun around the earth.)

Of the planets easily observable to the naked eye, Mars has the most eccentric orbit. Building a model that could predict the position of Mars was the most difficult, and it was Mars that caused the most problems for the principle of uniform circular motion. (Actually, Mercury has a more eccentric orbit, but there was much less data for Mercury due to its closeness to the sun.)

This is a more detailed example of the Ptolemaic model for Mars. In the diagram below, the line segment EM is the line of sight from the earth to mars.
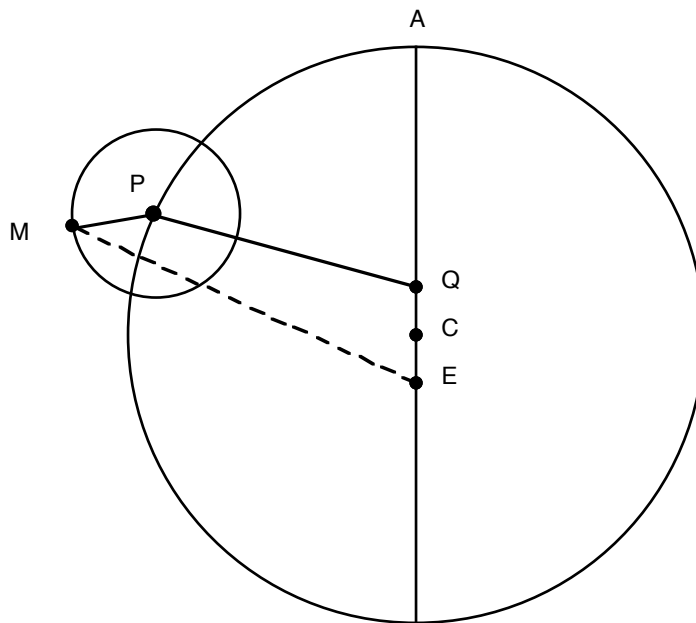
E is the Earth
M is Mars
C is the center of the deferent for Mars
Q is the equant point for the deferent of Mars
P is the center of the epicycle for Mars
A is apogee for Mars (farthest from Earth)

$$\overline{EC} = \overline{CQ}$$

The epicycle rotates at a constant angular speed. At the same time, the center of the epicycle, P, is moving on the deferent such that the line segment PQ rotates with a constant angular speed. The equant was an invention of Ptolemy. He devised this so that he could accurately predict the positions of the planets while retaining some semblance of the principle of uniform circular motion. (The motion of Mars around the deferent was now non-uniform with respect to the center of the deferent, however.)

This model was used to calculate the longitudinal position of Mars. To calculate the latitude, a different set of calculations was done.