

Hindu Astronomy, see link for the wikipedia article

https://en.wikipedia.org/wiki/Nilakantha_Somayaji

Nilakantha (~1440AD) developed a computational system for a partially heliocentric planetary model in which Mercury, Venus, Mars, Jupiter and Saturn orbit the Sun, which in turn orbits the Earth, similar to the Tychonic system later proposed by Tycho Brahe in the late 16th century. Most astronomers of the Kerala school who followed him accepted this planetary model.[5][6]

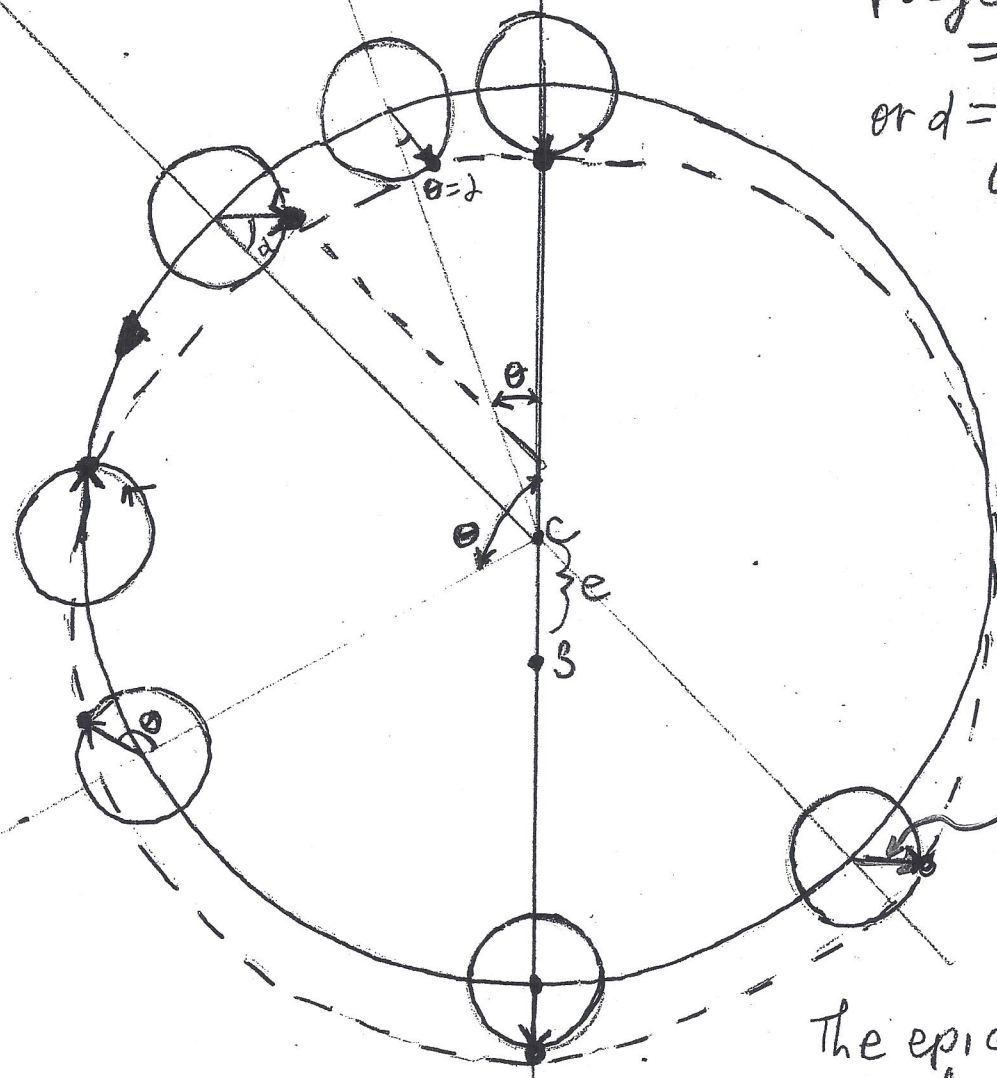
Tychonic System
 (1) Sun orbit Earth
 (2) Mercury, Venus, Mars, Jupiter & Saturn orbit Sun

Jupiter

Saturn

Copernican
eccentric
deferent +
epicycle

eccentric deferent
with an epicycle
epicycle period
= $\frac{1}{2}$ deferent
or $d = \theta = \lambda$ hold not
ccw rotation
on deferent
+ epicycle



$e =$ planet
orbital
eccentricity

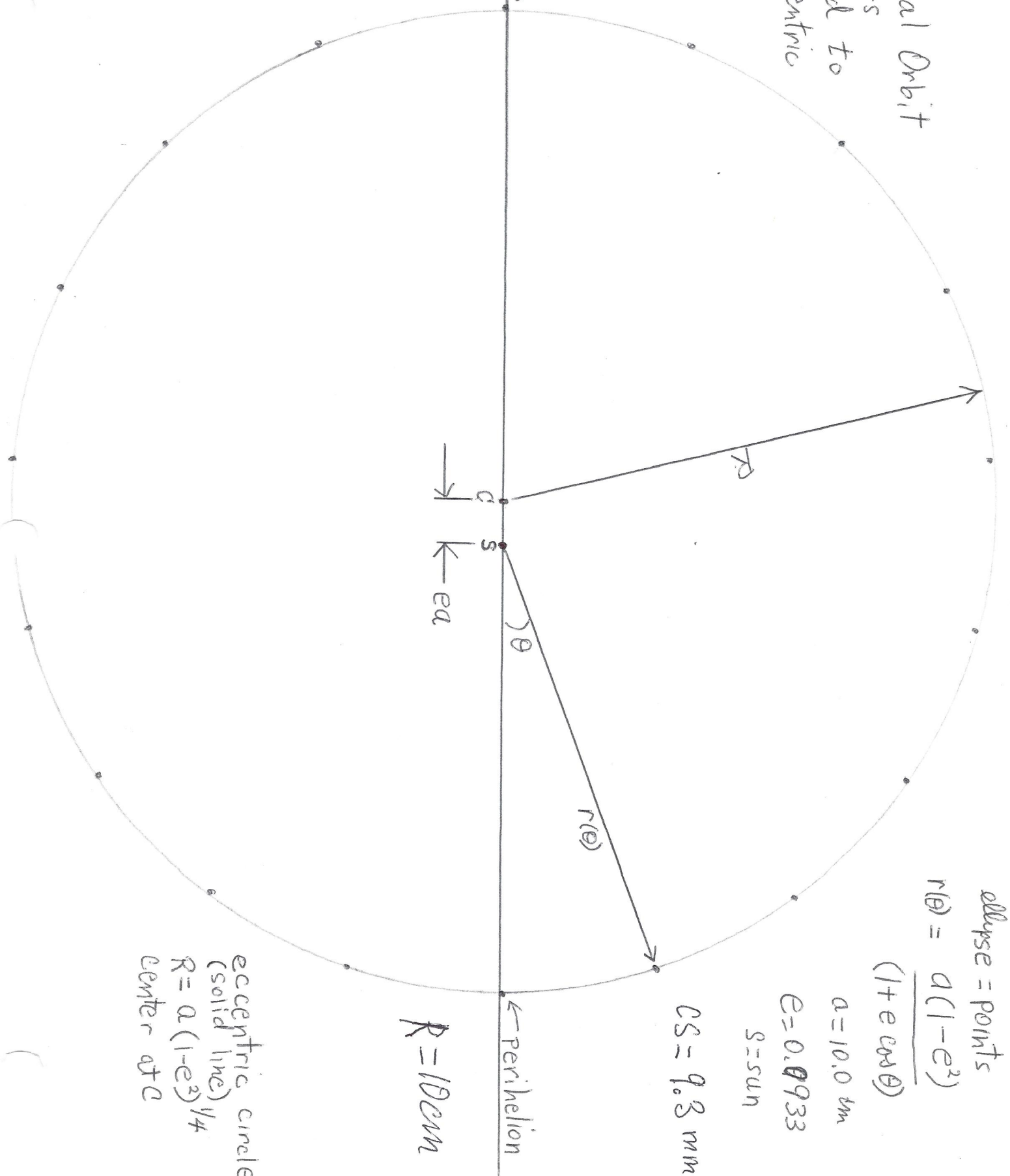
radius =
 $e/2$

The epicycle
anomaly $d = \theta$
in Copernican
planetary system

Epicycles take the place
of the equant. Copernicus'
attempt to mock up the elliptical orbit.

The epicycle orbits are considerably smaller than
the epicycle radius in geocentric system

Elliptical Orbit
for Mars
compared to
an eccentric
circle.



ellipse = points

$$r(\theta) = \frac{a(1-e^2)}{(1+e \cos \theta)}$$

$a = 10.0 \text{ km}$

$e = 0.0933$

$s = \text{sun}$

$CS = 9.8 \text{ mm}$

$R = 10 \text{ km}$

eccentric circle
(solid line) 1/4
 $R = a(1-e^2)^{1/4}$
 center at C

Example of an ellipse with eccentricity = 0.0933

Ellipse, $r(\theta) = a \cdot (1 - e^2) / (1 + e \cdot \cos(\theta))$

r is distance from the sun,

θ is the angle as measured from perihelion

enter a, eccentricity 10.,.0933

initial angle, step size 0.,.20.

θ	$r(\theta)$
0	9.067
20	9.113905
40	9.251713
60	9.471124
80	9.754909
100	10.0762
120	10.39802
140	10.67598
160	10.86557
180	10.933
200	10.86557
220	10.67598
240	10.39802
260	10.0762
280	9.754909
300	9.471124
320	9.251713
340	9.113905
360	9.067

① Draw a circle radius 10 cm about C

② place sun(S) 9.3 mm away from C

③ plot the points P using $r + \theta$

